WORKING PAPER ONLY - DO NOT QUOTE
DOCUMENT DE TRAVAIL SEULEMENT - NE PAS CITER

TRANSIT USERS AND NON-USERS
FACTORS AFFECTING MODE CHOICE:
An Evaluation of a New Methodology

Final Report submitted to

Consumer and Corporate Affairs Canada

by

Ian Fenwick[1]

Roger Heeler

and

Patricia Simmie

December 1981

[1]Ian Fenwick and Roger Heeler are Associate Professors of Marketing, Patricia Simmie is Assistant Professor of Marketing in the Faculty of Administrative Studies, York University. This project was carried out under the auspices of the Management Science in Marketing Research Group, York University.

The views presented in this paper are those of the authors and do not necessarily reflect the views or positions of the Department of C.C.A.

CONTENTS

		Page
1.0	Introduction	1
2.0	Demand Models	2
3.0	Consumer Segmentation Studies	8
	3.1 Users and Non-Users	8
	3.2 Attitudes, Perceptions and Evaluations	10
	3.3 Demographics, Transit Use and Car Ownership	15
	3.4 Travel Time Budges	21
	3.5 Potential Switchers	22
	3.6 The Elderly, the Handicapped and Women	23
	3.6.1 The Elderly	23
	3.6.2 The Handicapped	25
	3.6.3 Women	26
	3.7 Benefit Segmentation	28
	3.8 Summary	31
4.0	Ex Post Experimentation	38
5.0	Conclusions from Literature Review	40
6.0	Measurement of Commuters' Travel Values:	41
	A field test	
	6.1 Methodology	41
	6.1.1 Questionnaire	41
	6.1.1 Sample	44
	6.2 Results	45
	6.2.1 Questionnaire Completion	45
	6.2.2 Profile of Respondents	46

CONTENTS

		Page
7.0	Transportation Mode Attitudes, Perceptions and Scenarios	49
8.0	Factor Analysis of Transportation Mode Ratings	55
	8.1 Perceptual Maps	60
9.0	Conjoint Analysis of Scenario Preference Data	75
	9.1 Conjoint Results	77
	9.2 Individual Conjoint Results	82
10.0	Modelling of Transportation Mode Choice	86
11.0	Conclusions	98
	11.1 Recommendations	99

APPENDICES

Appendix 1	Questionnaire	101
Appendix 2	Conjoint Scenarios	110
Appendix 3	Verbatim responses to question 4.9	113
Appendix 4	Individual utilities, cluster 2	121
References		133

1.0 INTRODUCTION

The aim of this study is to determine how users and non-users of public transit for commuting to work differ in their perceptions of the available modes, and in the trade-offs they are willing to make in selecting their preferred mode. Data collection will be confined to individuals working in the Metropolitan Toronto region who could be considered to have a choice of public or private transit modes.

It is expected that users and non-users will differ in the extent to which they are willing to give up one attribute (e.g. comfort) in favour of another (e.g. lower cost). It is also expected that users and non-users will have different perceptions of the extent to which transportation modes (public vs private) provide each attribute. An underlying objective of the study is to provide a framework for a cost-benefit approach to changing the characteristics of transit systems in order to increase ridership and thus reduce consumption of gasoline by private cars.

The first step in this process is to review the recent literature pertaining to urban transit systems and consumer demand. The particular areas of interest include models of consumer choice, reasons for mode choice and characteristics of transit users and non-users.

2.0 DEMAND MODELS

A major focus of transportation research over the last few years has been the estimation of aggregate transit demand models using disaggregate data. The objective of these models is to relate measures of transportation usage to characteristics of the transit system (price, travel time, etc.) and to characteristics of the individual user (age, income, occupation, etc.). These models aim to provide a consumer based decision making framework for transit system manager, enabling them to assess the impacts of various policy alternatives such as raising fares or improving service. This type of study has proven popular and valuable for a number of reasons. Models using aggregate data can be developed more cheaply than those requiring full-scale consumer surveys. In addition, aggregate models provide information at a transit zone or census tract level as to who is using the system, and what the impact of changing the characteristics of the system would be. Such information is of immediate interest to transit managers.

The primary interest of these models for our research is the variables which have been identified as significant predictors of consumers' mode choice. The studies reviewed here have been selected as key examples, illustrating the general approach and typical findings. Although there is a wide variety of studies in this field, those reviewed below highlight the full range of variables employed.

There are two basic modelling approaches: multiple regression analysis and logit analysis. Multiple regression analysis takes some measure of traffic volume as its dependent variable and uses as its predictors cross-sectional data, usually at the zone or census tract

level, on consumers' socio-economic characteristics (e.g. Agrawal 1978; Costantino 1975; Reichman 1978; Transport Canada 1975).

Logit analysis has become much more popular in recent years. Based on the logit model developed by McFadden (Zarembka 1973), logit analysis takes the consumer's mode choice as the dependent measure. This is then related to characteristics of both the consumer and the models available. This "revealed preference" type of model has proved to be very valuable in the transportation field. One of it's major strengths is that it concentrates on the individual consumer rather than using data at the census tract level as is typical of the regression models. Some examples of models using the logit approach, or some variant of it, are Transportation Model Development Program 1979, Koppelman 1976, Gaudry 1978, Cleroux et al 1979.

Although all these models, whether regression or logit, purport to be estimating transit or mode demand, the concept is not operationalized in a consistent manner. Koppelman (1976), Gaudry (1978), Cleroux et al (1979) and Transportation Model Development Program (1979), as logit analyses, all use mode chosen or market share as dependent variables. But the regression models employ a wide range of dependent variables: e.g. number of full-fare riders (Agrawal 1978), demand for morning transit work trips (Constantino 1975; Frankena 1978), self-reported transit usage rate (Transport Canada 1978). This inconsistency could result in confusion as to which characteristics are most important in affecting transit demand: if demand is not measured consistently, researchers are unlikely to agree on its determinants.

The predictors used in these studies are summarized in Table 2.1.

TABLE 2.1

PREDICTORS USED IN DEMAND MODELS

Cost of trip

- Average fare (1, 3, 4, 5, 8, 9)*
- Retail price of gas (7)
- Average cost of downtown parking (2, 6, 8)

Service

- Vehicle miles of service (1, 4, 9)
- Accessibility (3, 9)
- Frequency (3)

Travel time

- In-vehicle time (5, 8)
- Access/egress time (8)
- Distance travelled (8)
- Waiting time (5, 8)
- Combination of above (2, 6)
- Bus headway (8)

Availability of automobile

- Number of females in labour force (3, 4)
- Households with no car (2, 3, 6, 7, 8)
- Number of multiple dwellings (3, 9)
- Household income (2, 5, 7, 9)
- Age/education of head (3)
- Number of workers in household (6)
- % of population less than 15 and over 65 (4)

TABLE 2.1 (cont'd.)

Miscellaneous

Number of non-agricultural workers (1,2)

Number of CBD workers (3,4)

*Numbers in brackets refer to the following studies:

1. Agrawal (1978)
2. Cleroux et al (1979)
3. Costantino (1975)
4. Frankena (1978)
5. Gaudry (1978)
6. Koppelman (1976)
7. Riechman (1979)
8. Transportation Model Development Program (1979)
9. Transport Canada (1979)

Although a very large number of variables are listed, researchers are attempting to measure a relatively small number of constructs. These more general constructs include cost of a trip (average fare, price of gas, cost of downtown parking), availability of an automobile (household income, number of females in labour force, number of people under fifteen and over sixty-five), service provided by the transit company (vehicle miles of service, frequency, accessibility, age of bus, residential density, access/egress time), and travel time (access/egress time, waiting time, bus headway, in-vehicle time). In addition, there are a number of demographic variables, some of which have been included in this table, which tend to indicate potential auto availability, such as sex, income, occupation, education, etc.

Unfortunately, each researcher operationalizes the constructs on his own assumptions, data availability, or whatever. Although there is general agreement about what the underlying constructs are, it is clear that our ability to make a definitive statement about the impact of changing these variables is hampered by this measurement confusion. In addition, we must worry about consumers' perceptions of these constructs, which may differ quite dramatically from the transportation researcher's idea of what consumers should think. These issues are discussed further below (e.g. Section 3.2).

One type of macro-level model which is sufficiently prevalent that it deserves to be addressed separately is the price-elasticity estimation model (see for example Ugge and Dalton 1977, Lago et al 1981, Ferreri 1979). Ferreri (1979) found in a survey of the forty largest transit companies in the United States that 79% were attempting to measure the impact of fare changes on ridership. The traditional measure used by

transit organizations was the Simpson-Curtin formula (derived in 1947) which said that price elasticity is -.3. The obvious problems associated with applying one 30-year old estimate to all transit systems has stimulated many different modelling efforts. However, Simpson-Curtin is still widely used.

Lago et al (1981) provide a comprehensive review of studies of demand elasticity for transit systems in Canada, the United States, and Great Britain. These studies are of two main types: those that monitor the impact of fare changes, free passes, etc., and those which have a non-experimental approach, utilizing either time series or cross-sectional data. Their general overall finding is that transit demand is inelastic to fare changes -- elasticities ranged from -.04 to -.87, with a mean of $-.28 \pm .16$.

Ugge and Dalton (1977) studies both fare elasticities and service elasticities in sixteen urban areas in Ontario, obtaining information on monthly ridership, revenue, revenue-miles, fare levels, service change, and strikes. Their results show that a change in service can be expected to have a much larger impact on ridership than a change in fare (service being defined as an increase or decrease in vehicle miles).

A problem with these studies is that there has been no attention paid to cross-elacticities of price of other modes of transit. In particular, many researchers are now interested in the impact of the rising price of gas on ridership. The aggregate nature of the models results in an inability to describe some of the behavioural dynamics occurring in today's market.

3.0 CONSUMER SEGMENTATION STUDIES

The dominant trend in transportation research is towards a more direct understanding of the individual transit consumer. These tudies are concerned with the characteristics of transit users and non-users, their perceptions of the different transportation modes, and the importance of various attributes of the transit system to different groups. The underlying hypothesis is that there are market segments who differ in their potential to become regular users of public transit. Initiatives taken to increase transit usage must be directed at market segments where a reasonable return to effort can be expected. A simplistic approach of attempting to turn "non-users" into "users" of the public transit system is doomed to failure. If a transit marketer is able to determine the characteristics of users and non-users, for example, or the transit usage behaviour of young women versus young men, then there is potential for designing programs targeted at these groups. This move away from "mass transit" and towards a segmented market has been a major theme of recent transportation literature.

3.1 Users and Non-Users

The first step in these studies is to define a "user" and a "non-user" of public transit. Because there are differing degrees of public transit usage, many researchers have adopted scales of use--non-use. Lovelock (1973) asked respondents to categorize themselves into one of six categories:

- I don't use public transportation and I never have in the past.

- I don't use public transportation at the present time, although I have used it in the past.
- I occasionally use public transportation, but only when I have to.
- I occasionally use public transportation by choice.
- I am a regular user of public transportation because I have no alternative.

The Toronto Transit Commission (1981) defines a non-user as someone who has used the TTC less than 3 times in the last month, a light user as someone who has used the TTC 1-3 times in the last week, a medium user has 4-9 rides in the last week, and a heavy user has taken more than 9 trips. Hickey (1978) and Day (1978) apply a very similar classification.

There is also concern with whether an individual has a choice about whether to take public transit or not. Typically, any household without a car is defined as a transit captive or transit dependent (e.g. Behnam and Thomson 1976; Bochner and Stuart 1978). The definition of whether an individual has a choice of mode is made either on the basis of the transit system's coverage of the area (Gilbert and Foerster 1977; Behnam and Thomson 1976), or by asking the individuals if they perceive that they have a choice of transportation mode (e.g. Blankenship 1976).

Day (1978) identified transit captives as being those who could not drive, or did not have a car available, and tended to be elderly (or else very young), handicapped and at the low end of the income scale. Blankenship (1976) presents similar findings, adding school commuters and respondents that believe "traffic is unbearable". Warrington (1981) finds many transit captives to be older teens without drivers licenses,

The issue in all these classifications of riders/non-riders and transit captives is that people's needs and attitudes related to the transit system may vary according to level of, and reason for, transit use.

3.2 Attitudes, Perceptions and Evaluations

Vanier and Watruba (1977) report that, in their sample, riders and non-riders tended to agree on the relative importance of transit features but differed in their satisfaction with those features. Both riders and non-riders expressed a desire for a smooth comfortable ride, with no threat to personal security and were unconcerned with travel speed (this contrasts with Toronto Transit Commission 1976, where speed was a major reason for light transit use). Both groups felt that waiting time was important (see the discussion in Section 3.7) and particularly valued bus stop proximity. Non-riders rated routes and schedule frequency as the most important system attributes, whereas riders stressed attributes of the driver. Neither group rated fares as of major importance, although both groups were most satisfied with this attribute.

These findings on attribute importance are supported by several other studies. Behnam and Thomson (1976) found that non-users of transit in Milwaukee stressed less waiting time and a more punctual service as high priority system improvements. Luehring and Selby (1981) reported that BART non-users most often cited more frequent scheduling and extended routes as important improvements to the transit system. In the four U.S. cities studied by Chadda and Mulinazzi (1977) 70% of transit riders lived within 3 blocks of a bus route. Day (1978) found that accessibility to transit stations dictated ridership levels. Market

share for GO Transit declined from a high of 41.2% of all trips when origin and destination were within a 10 minute walk of transit stations, to 1.8% when origin was a 10-15 minute drive from the suburban station and destination a 15-20 minute walk from the downtown station.

The low importance attached to fares is attested to by a number of studies. In particular, Environics (1981) reports that 50% of non-riders and 37% of light-riders indicated that they would not use the TTC even if it were free (see also Section 3.7 below).

Looking at satisfaction ratings, Vanier and Watruba (1977) show that non-users rate all transit characteristics less favourably than do users, and are particularly critical of routes and schedule frequencies (both important attributes). Users of transit, however, are seen to be most satisfied with transfers and characteristics of the driver.

Interestingly, while transit users claimed to travel mostly during weekday rush-hour, transit non-users (if they rode transit at all) were more likely to travel on week nights. This difference in usage time suggests a different pattern of trip purpose between riders and non-riders which could in itself explain part of the reported differences in attitudes and evaluations. Hartgen (1972) reports that the attitudes of travellers who have cars available are influenced by the characteristics of the particular trip being taken. So the car owners' mode bias was found to change from trip to trip. Nash et al (1969) distinguished work and non-work trips, finding that speed, punctuality and timing were the most important attributes for work trips. Clearly, the demands the consumer makes on the transit system are crucially conditioned by trip purpose. Gratwick (1980) points out that shopping trips require the traveller to carry packages. Many transit systems have limited storage

area, decreasing usefulness for trips of this type. Similarly many recreational journeys have destinations not served by public transit, eliminating this.

These studies are important in suggesting that consumers' attitudes towards, evaluation of, and even use of transit system should not be analyzed in isolation from their trip purpose. Research which is not grounded on a well specified trip purpose scenario may be seriously misleading. Situation-specific research, which has recently been adopted by marketing researchers, is clearly appropriate in the transit field.

Vanier and Watruba (1977) also found riders had a more favourable overall perception of public transit. The relationship between perception and use is complex. Warrington (1981) points out that "ignorance of transit characteristics appears to be closely associated with non-use". Similarly Lovelock (1973) finds infrequent riders know less of the specifics of transit services in their community. Clearly, the direction of causality is questionable: do riders acquire knowledge, and favourable attitudes, as a result of transit usage, or is a favourable preception a pre-requisite for becoming a transit user? This question is as unanswered in transit research, as it is in marketing and psychology. Several researchers have suggested however that attitudinal data is not in fact a good indicator of travel behaviour (e.g. Hartgen 1972; Dobson et al. 1978) although Rosapep (1980) reports that attitudes do affect mode choice behaviour and can be used to distinguish market segments.

Interestingly, mis-perception of automobile related costs is very prevalent amongst car users. Henley et al (1981) and Day (1978) found that only about 10% of those surveyed could provide estimates of daily,

weekly or monthly driving costs. Users tended to underestimate the fixed and operating costs of using a car in comparison to a bus. L. L. Hoag (1975) found that less emphasis is placed on the cost of purchasing and maintaining a car (parking, checkups, etc.) than is placed on taking money out of pockets and placing it in the fare box. Again the direction of causality is debatable. Do drivers use private motor vehicles as a result of their ignorance of automobile running costs, or do they adjust their perceptions of costs to justify a prior decision to travel by car (and avoid cognitive dissonance)?

Hoag (1975) mentions another element of perception which has hurt mass transit; perceived safety and security. What people perceive about safety and security is more important than reality. He cites a study of public transportation users in Chicago which revealed that although less than 5% of the total number of passengers were either victims or witnesss of crime, 70% of the riders felt crime was somewhat likely to occur. Nearly 25% of the passengers reported that they declined to ride a city bus out of concern for crime.

Mitchelson and Gauthier (1980) classified transit users into one of three segments based on attitudinal data:

- The Unbiased Segment - very sensitive to seating arrangements, insensitive to changing levels of travel burden.
- The Bus Biased Segment - most sensitive to changes in individual seating, sensitive to passenger number allowed in the vehicle, nad sensitive to passenger protection. Particularly insenstiive to level of privacy. Most sensitive to alterations in one way fare and environmental pollution levels.

- Auto Biased Segment - highly sensitive to the ability (or lack of) to restrict passengers with whom one must associate. They are significantly sensitive to attributes of convenience and privacy. They are also particularly sensitive to changes in the cost of vehicle parking and access time. They are not sensitive to environmental pollution levels.

The demographic characteristics of these segments are discussed below (See Section 3.3).

Brown (1974) suggests that riders are more sensitive to system characteristics because their socio-economic constraints make them more dependent on transit.

Differences in atitudes, life-style, or "psychographics", between transit users and non-users have been recorded. Vanier (1979) found that transit riders tended to be:

- More methodical and habit prone
- more sensitive to price reductions
- more concerned with cleanliness
- more likely to enjoy participating in group oriented activities
- less interested in the strictly entertainment aspects of social interaction
- more likely to believe in the tensions of modern living and to show a liking for nostalgia than non-riders

The non-rider tended to value the importance of exterior looks, to buy quality brands, to be more self-confident, independent and secure, and to accept pollution as the inevitable price of progress. Clearly, many of these life-style attributes are closely associated with non-riders' superior socio-economic position.

Crosley (1981) found subway riders to be more environmentally

concerned, helpful, friendly, intelligent, cultured and honest than non-riders. Again demographic differences (Crosley's subway riders were younger and better educated than non-riders) may explain some of these characteristics.

Blankenship (1976) in a study of transit users in Orange County, California, looked specifically at those riders who were least concerned about social status when riding a bus. They were found to be earning $10,000 (1974 $) or less per annum, to be middle-class, transit dependent, comfortable talking to strangers and not to mind who else was on the bus.

3.3 Demographics, Transit Use and Car Owership

In demographic terms, Wiese (1978) identified transit riders as being largely city dwellers, low income and from racial and ethnic minorities. These may however be characteristics of transit supply rather than determinants of demand. Oppenhiem (1976) in an analysis of San Francisco Bay residents, found that non-riders tended to have high professional status, high car availability and a low level of proximate public transit service. Oppenheim also classified commuters according to demographics and life-style. He found that single urban residents had a definite travel behaviour, characterized by convenience of travel and reduction of travel activity. Members of large families who did not work, tended to travel for the purpose of taking another family member to work or school. A significant part of this group travelled only by walking. Among the lower socio-economic class, 57% of the population did not go out for leisure at all because of lack of resources and a car. One half of the "satisfied affluent" groups (those who were happy with

their residential area and personal affluence) did a large amount of travel for leisure with exclusive use of a private car. The middle class single was less likely to travel for the sake of leisure, and used his/her car less than other groups for that purpose. He/she travelled more for work and was more likely to use public transit.

Costantino (1975) suggests that inadequate routing in the suburbs is a major reason for transit non-use. This problem may be exacerbated by the fact that a large proportion of central business district workers are white collar workers living in suburbia, while blue collar jobs are increasingly located in the suburbs.

Guseman and Hatfield (1978), studying cities with populations of less than 400,000 found the four largest segments in order of propensity to ride transit were (1) the elderly, (2) blue collar females, (3) housewives and (4) white collar females. Guseman and Hatfield found that males generally had service requirements which were hard to accommodate, namely that transit trips should take less time than automobile trips, and that the bus should drop them off and pick them up at home.

Riechman (1979) discussed the relationship of volume of travel to education levels. He found that at higher levels of education and income, some reduction in overall mobility and work trips was observed. Lower educational levels were found to be associated with jobs not permitting trips during working hours, whereas a high level of education presumably allowed a greater flexibility in subsistence travel, especially business trips. Riechman claimed that education had a mixed interaction with mobility: - positive to a certain level, then becoming negative.

Hartgen (1972 found that the most powerful explanatory variable

for number of automobile trips taken was income, followed by occupation. Brown (1974) found that car commuters with lower income nevertheless had a need for good bus service because they could not afford a second car and wanted good service for other members of their family, and they also commuted periodically themselves. This group was found to be very sensitive to parking costs and any increase would cause them to shift transport modes. As income increased, the resistance to mode shift increased.

Webber (1979) provides a distribution of BART riders by income as follows:

INCOME	BART Riders distribution (%)
less than $5,000	10.5
$5,000 - $6,999	6.8
$7,000 - $9,999	12.6
$10,000 - $14,999	21.6
$15,000 - $24,999	30.6
$25,000 and over	17.8

Webber points out that the poor tend to make disproportionate use of overland mass transit. In 1970, in the U. S., people with income of less than $6,000 (35% of the U. S. population) accounted for 23% of commuter rapid transit and 42% of bus and streetcar trips. Households with annual incomes greater than $15,000 accounted for 20% of rapid transit travel and only 8% of bus and streetcar commuters (a tendency for the wealthier to avoid slower public transit modes). Nash (1976) also found that many bus users in Britain were from poorer sectors of the community.

High car availability is an important characteristic of transit non-users. Non-users of transit display a greater orientation towards,

and preoccupation with, the automobile and car users have a tendency to use their vehicles even for short journeys (Oppenhiem 1976). A recent TTC study also found a large percentage of non-, and light-public transit riders were "car committed" (Environics 1981). Hartgen (1972) found that automobile availability was the single most important explanatory variable of mode choice. Similarly, Kingham (1978) reported that for work trips in Washington, D. C., the usage of car pooling and public transit fell greatly as the ratio of automobiles available per worker increased. Hsu (1975) shows that the reduction in a household's use of mass transit is most notable after acquisition of a second car.

To an extent, the demographics of transit usage are the demographics of low car availability. Systems Approach Ltd. (1979) found that families without a private vehicle tended to live in heavily populated areas; to have low incomes; to be childless couples or single-parent families or over 65 years old: an elderly person was four times more likely to be without a car than the average person.

Households with one adult were found to be a low % of the families with cars in Canada (approximately 33%). This percentage increased dramatically for households with 2 or more adults in them (approximately 73% of these households had at least one car).

Luehring and Selby (1981) point out that those most likely to say they need their cars for work:

- had commuting expenses paid by their employers
- had work hours which varied
- were male drivers with incomes greater than $35,000 (1981 $)
- started and finished at unconventional times

Luehring and Selby also provided a breakdown of work activities which required cars:

	% of respondents indicating they need a car for this activity:
- sales calls and seeing clients	(54%)
- deliveries and pick-ups	(9%)
- going to different job sites	(8%)
- cartage of equipment	(8%)
- visiting branches and stores	(8%)
- visiting patients and hospitals	(7%)

Wiese (1978) showed that car drivers perceived the following advantages of driving their car to work: flexibility (mentioned by 53%), speed (by 43%), convenience in making stops (33%), protection from the weather (11%).

Notice, however, that the crucial variable is car availability, not car ownership (and number of cars owned) to determine availability.

Kingham (1978) found that households with less than one car per worker (which were concurrently those households which were transit dependent) were principally living in apartments and townhouses (82%). Households with more than one car per worker lived mainly in single family homes.

Kingham also found that number of automobiles per worker was influenced by the following factors:

- household composition (specifically number of adults)
- presence of transit alternatives
- income
- dwelling type (mentioned above)
- household size

Bochner and Stuart (1978) found in their St. Louis Study that there was a difference of 30-35% in the number of trips taken between persons in zero and one car households. Lea and Associates (1975) found that the vehicle which the household termed its "first" vehicle was used mainly for driving to work, especially in households who felt they lacked adequate transit service. The main reason cited for owning more than one car was that the first car was used for business.

Blankenship (1976) found that younger, better educated, higher income individuals in professional, technical or managerial positions, were less inclined to believe that cars must remain the dominant mode of transit.

Mitchelson and Gauthier (1980) found that bus-biased travellers (see above Section 3.2) were likely to be female, renting a house, unemployed (or not employed outside the home) and of low income. Auto-biased travellers were more apt to be male, homeowners, better educated, employed full-time, 21-29 years old at the higher end of the income scale. Unbiased travellers were more likely to be female, have children, be unemployed (or not employed outside the home) and of low income.

Oppenhiem (1976) found a close correspondence between leisure travel and the private car. The more one travelled for leisure purposes, the more use was made of a private car. Oppenhiem also found that those who used the car for work tended to use it for shopping too.

Hartgen (1974) characterized many drivers as "psychologically committed" to cars because i) people display loyalty to expensive personal property, and ii) there is the possibility that the individual's pre-existing bias towards the car will direct subsequent trip purchases. Warrington (1981) identified two segments within "auto captives": the

suburbanite who lives too far from public transit to reach it conveniently, and the highly affluent commuter who sees his private car as a status symbol more important than the economies and amenities offered by public transit. The inaccessible segment is supported by the findings of Day (1978) and Vanier and Watruba (1977) discussed in Section 3.2. The existence of the status segment relatively immune to economic conditions is shown by Luehring and Selby (1981). They found that 78% of the San Francisco Bay Area Ferry riders surveyed felt that using buses or ferries was cheaper. More significantly, 60% of the automobile drivers felt the same way. Luehring and Selby, along with Y. Zahavi and Talvitie (1980) showed that car drivers were likely to continue using their cars even in the face of exorbitant gas prices. Zahavi and Talvitie point out that in 1973-75 (when there was dramatic increases in the price of gas), people saved on fixed costs (for example by decreasing their rate of car replacement) rather than decreasing travel.

Behnam and Thomas (1976) pointed out that those people who were multi-car owners did not look at fares as an important attribute to consider when evaluating public transit. Instead, Behnam and Thomson found a trend of placing increasing emphasis on system improvements of the public transit system (such as privacy and fewer transfers) as the number of cars owned by the respondent increased.

3.4 Travel Time Budgets

Bochner and Stuart (1978) in a study of St. Louis, suggested that users of transport have travel time budgets regardless of transportation mode, income, or any other factors. Those using public transit spend more time travelling to and from work than do auto users, and as a result

travel less for non-work purposes (e.g. shopping or social trips). Travel time budgets were estimated to be about the same for rgular transit riders and the population in general, an average of 1.12 hours per day. Guilano (1979) also used the concept of travel time budgets to conclude that there was a "latent" demand by transit users for shopping and recreational trips. Transit users made fewer trips overall because of the longer average trip time associated with public transit journeys. The same predictions would follow from travellers having a negative utility for trip duration: the longer the average trip duration the fewer the number of trips made.

3.5 Potential Switchers

A few researchers have concentrated on "potential switchers", i.e. individuals currently not using, or lightly using, public transit but having the potential for greater usage. Luehring and Selby (1981), using discriminant analysis, profile switchers as:

- average age 30
- more likely to be full or part-time students (although 60% were not students)
- having smaller households
- being more likely to shop in the downtown area
- having a higher education

than non-switchers. Unlike captive riders, this group has the option of private auto available for commuting but may choose mass transit for other reasons relating to personal values, etc.

Fielding et al (1976) defined "high potential users" as having no cars, earning less than $7,900 (1973 $) and being in the 12-17 year old

or 36-65 year old bracket. They also defined an absolute non-switcher market (those who would never use public transit regardless of proximity) as being 18-24 years old, having a house with 2 or more cars and making at least $25,000 (1973 $) per year.

Warrington (1981) suggests that the "modal choice traveller" is a more broadly defined group, consisting of many commuters, shoppers, students, tourists and families making recreational trips to local facilities, being largely middle to upper income, suburbanites between the ages of 18 and 54. This does not seem to be supported by the empirical research discussed above.

Gensch and Torres (1980) also suggest there are many segments who have the potential to switch to public transit. They place switchers on a continuum from those who do not consider mass transit as a workable transit alternative, to those who feel relatively indifferent about the alternatives of driving and mass transit (although even this group will require some impetus to switch modes). A recent TTC study (Environics 1981) estimated that 20% of the car-committed segment were potential switchers.

3.6 The Elderly, the Handicapped and Women

An alternative approach to market segmentation is to define a set of consumer characteristics a priori and then look at transit usage for that particular group of consumers. The three groups most often singled out for special analysis are the elderly, the handicapped and women.

3.6.1 The Elderly

Much of the research on the elderly examines this group's attitudes

towards transportation in general, and public transit in particular. Brown (1974) found that older people place greater emphasis on efficient transit service than do younger people. Behnam and Thomson (1976) found that the elderly (over 65 years old) ranked the benefit of lower fares as much more important than did younger groups. The elderly also placed more emphasis on comfort factors (such as having a seat) and safety (avoiding annoying individuals).

Similarly, Cohen and Hyde (1980) claimed affordable transit was central to the elderly's choice of mode, finding that elderly travellers perceived public transit as more costly and less convenient than travel in their own or other's cars. Cohen and Hyde also found that the elderly did not use public transit for social or recreational trips. Even fewer elderly were found using public transit on trips with more than one destination. Hoag (1975) found that older people may feel uncomfortable, seeing themselves as contributing to the slowing down on loading and unloading of the vehicle. As a result they may choose to avoid public transit.

Gillan and Wachs (1976) found a large number of elderly non-drivers, living in areas serviced by public transit, did not travel. 31% of elderly persons aged 64-69, 37% of those 70-74, and 51% of those over 75 years old did not travel. Furthermore, a large proportion of taxi cab users were elderly (over 65 years) and many of the cab rides taken were short distances. This was interpreted as indicating a latent demand for improved public transit service.

The relative immobility and/or transit dependence of the elderly is supported by a number of researchers. Riechman (1979) reported a direct negative relationship between mobility and age. Guilano (1976) suggested

that "tomorrow's elderly will be left in the declining suburbs, (and) will suffer from too low a density to maintain social interaction and...vital services without public transportation". Gillan and Wachs (1976) found that income moderates declining mobility until age 70, when mobility falls for all income groups. Similarly Mossman and Faria (1975) derive a mobility index which shows household trip making increases with income, automobile availability and age of household head -- but only up to 54 years old, thereafter mobility decreases sharply. Mobility is in any case lower for females. These findings tie in with those on transit usage reported above (Section 3.1) as Oppenhiem (1976) reports that public transit is not generally used by types who travel most (this is also supported by research on travel budgets, Section 3.4 above).

Systems Approach Ltd. (1979) found a large proportion of the elderly lived alone, and a high correlation between living alone and "carlessness": 84% of the elderly living alone had no car. Guilano (1979) noted that 70% of the elderly using public transit were females.

3.6.2 The Handicapped

In Hoag (1975) the handicapped are classified into 5 different groups, these are:

1. The aged who need physical assistance
2. Those with visual, auditory or vocal deficiencies
3. Those with neural or coordinative problems such as palsy
4. Semiambulatory persons requiring crutches, canes, braces, etc. Also those with spastic, cardiac or arthritic problems
5. Non ambulatory persons using wheelchairs

Besides those listed above, people who are pregnant, extra large or extra small are inconvenienced by facilities provided for the "average"

sized person. The size of the handicapped population is more than sufficient to warrant it being considered a key portion of the travelling public. Lyman (1975) claims that between 7% and 8% of the general population suffers from some physical disability. He cites surveys in the U.S. and the U. K. showing 3% of the general population to be handicapped to the point that they have problems with regular public transit. Lyman identifies 3 transit user groups within the handicapped segment:

1. Those who regularly use a special vehicle
2. Those who cannot take public transit but don't need a special vehicle, (e. g. epileptics)
3. Those who can use public transit but have difficulty doing so

There has been much pressure on metro transit systems to accommodate the handicapped more appropriately and some service changes have been made. For example, Stern and Adams (1980) describe an experimental project in Edmonton called DATS (Disabled Adult Transportation Service) to provide special transport facilities for the disabled. However, the literature reveals that in North America overall, many transit systems do not provide adequate facilities for the disabled.

3.6.3 Women

The general consensus from the literature is that women ride public transit much more than men. Day (1978) finds women more likely to do shopping trips and travel during off peak daylight hours. Behnam and Thomson (1976) reveal that women are more concerned about personal safety factors when riding mass transit while men emphasize time and delay factors. Blankenship (1976) and Luehring et al (1981) found that men were more auto dependent and less receptive to public transit.

Guilano (1979) presented a comprehensive study on women as transit users. Guilano showed that 73% of total car miles were driven by men. The article presents the findings of a 1973 Seattle Metro transit survey of patron origin and destination. This shows that while the population was equally distributed between men and women, 67% of public transit trips in the city and 61% in the suburbs were made by women. A similar survey in New York State (in 1974) found that outside New York City, female use of transit work trips outnumbered male use 4 to 1. For purposes other than work trips, 94% of the passengers were women. Guilano offers 3 reasons for this imbalance. First, for work trips, males were more likely to drive the family car; second, many office and retail jobs (predominantly performed by women) are located in central cities while larger industries (which employ more men) have moved to suburban locations. Central city jobs are more reachable by mass transit. Also, women are more apt to have lower paying jobs making mass transit's economy particularly attractive. Third, more of the elderly are women and there is an inverse relationship between age and possession of a driver's licence.

Guilano suggests that mothers of young children who don't work outside the home will make many short distance trips for both medical care and shopping. Door-to-door service would be appealing to this group so they could avoid carrying strollers and packages to bus stops. The main need for mothers of older children is reliable transit so that they do not have to chauffeur their children. Older women are the heaviest female users of public transit because many are not drivers (see above). For this group, door-to-door service would be valued as older women are frequent targets for personal crime.

3.7 Benefit Segmentation

Benefit segmentation -- an attempt to group consumers by the transit features they most strongly desire -- is relatively new in transit marketing. The most striking finding to date is that commuters do not rank fare cost as a very important transit benefit. Most people speak instead in terms of time-related benefits. These are of two sorts: waiting time and travel time.

Day (1978) presented evidence indicating that, apart from the lowest income groups, travellers are more sensitive to speed of service than cost in choosing transit modes. Nash and Hull (1968) found that avoiding a wait of more than 5 minutes was the single attribute yielding the largest perceived difference between public transit and private car. Webber (1979) points out that many studies, in a wide range of cities, conclude that time spent in vehicles is perceived as less onerous than time spent waiting, walking or transferring by a factor of 3 or 4 times. BART's planners originally believed "speed" to commuters meant spending a short time in transit vehicles but discovered that in fact travellers were much more concerned with access time. Golden (1980), in a conjoint analysis study, found that time, convenience and psychological safety were the most important variables for consumers. In particular, respondents were willing to pay $.40/mile more for transit which ran 6 days a week, 24 hours a day, at 15-minute intervals. These findings on the significance of waiting time, or punctuality, are supported by Nash (1976) and Fielding et al (1976) and by many of the studies discussed above in Section 3.2 (e.g. Vanier and Watruba 1977; Chadda and Mulinazzi 1977; Luehring and Selby 1981, etc.).

Blankenship (1976) defined time conscious individuals as those who consider riding a bus, drive to work 3 to 4 days a week, are 18-24 years old, from professional or technical households. G. R. Brown (1974) found that young people of low occupation and car ownership status for whom a car is seldom necessary, care a great deal about frequency of service. Moses and Williamson (1963) believe that for an individual to be diverted from their car to mass transit, they must be directly compensated for any cost and time advantages foregone. Fare decreases per se will not work.

Commuters also emphasize proximity of transit networks to their homes. Blankenship (1976) revealed that respondents were more familiar with distance to the bus stop than fare or service frequency. Crosby (1981) surveyed people in Washington and found that over half of those who rarely or never ride public transit, said they would consider using the car less if routes and stations were closer. This problem is particularly acute for people living in suburbia (see above). Fielding et al (1976) noted that demand fell heavily if the respondent lived more than three blocks from the transit route (see also Day 1978, discussed above).

Besides proximity of transit stations or bus stops, people were found to be concerned with the characteristics of the stations or bus stop themselves. Guseman and Hatfield (1978) found that many commuters felt that more benches and shelters were needed, as well as better routing to shopping centres. Hickey (1978) found that stations would be perceived as safer if lighting and communications systems were improved (see also Hoag 1975). Day (1978) found that many stations were in need of improvement as they were "cold, drafty, dirty, badly lit and uncomfortable.

Hartgen (1974) believes that situational as opposed to the actual modal factors are more important in predicting mode travel choice. Some key situational factors were (1) commuter's income, (2) distance to CBD, (3) familiarity with the area where the station was, (4) scenery, (5) comfort, (6) transfers, (7) cost and (8) age.

Some benefits which commuters recognize as being present in transit systems are the convenience of not driving or avoiding the fatigue brought about by driving a car (Luehring and Selby 1981; Chadda and Mulinazzi 1977). Luehring and Selby also reported that 26% of the 500 drivers in a San Francisco survey had decreased use of the car because of rising gas prices. This figure increased to 36% when the hypothetical price of gas was set at $2/gallon (but Zahavi and Talvitie 1980 found drivers continuing to use cars when gas prices rose and economizing instead by delaying car replacement. An Edmonton survey (1981) showed that riders used transit because of convenience, being less expensive and to avoid parking problems downtown.

Automobile riders also feel that privacy is a major motivating force for using the car to commute (e.g. Luehring and Selby 1981). Hoag (1975) pointed out the lack of privacy and of places for baggage as shortcomings of most mass transit. He has found research which suggested that travellers need "personal space" -- an area around the person regarded as private space. Factors found to affect this space were the proximity of others, visual contact, odours, and conversation. The private car protects a person's personal space. Related to privacy, Hoag also points out that research shows people seek to avoid others who are in different socio-economic classes or people with different attitudes and values. Again the car can help protect against this.

General comfort is perceived by many to be an important benefit. Nash (1976) found the probability of getting a seat to be behind only time and cost in importance. Fielding et al (1976) found seat availability to be the convenience factor ranked highest. Koppelman (1976) spoke in broader terms; using logit models to rank perception attributes he found general service, then convenience followed by psychological comfort to be the most important benefit needs. Crosby (1981) found that the factors perceived to be least important by existing commuters were (1) privacy, (2) qualification as a socially acceptable type of transit, (3) chance to socialize and (4) ability to listen to music en route. Like Koppelman, Crosby found overall service to be extremely important.

The Hart Research Foundation (Wiese 1978) found that 50% of commuters ranked availability of buses as the main problem with mass transit. Dependability of service was also questioned by one third of respondents. Other problems of lesser importance were inconvenient scheduling, lack of amenities, driver rudeness annd poor location of bus stops.

Stern and Adams (1980) found that bus ridership by low and high income groups, as well as by the young and elderly, was more service elastic for increases in service level than it was for middle income and middle aged commuters. Stern and Adams also found that those making recreational trips were more responsive to changes in service levels than those commuting to work.

3.8 Summary

In the studies reviewed above, two sets of variables are apparent:

characteristics of the transit system and characteristics of consumers. Both these sets of variables are operationalized in a multitude of different ways by different researchers. Table 3.1 summarizes the transit system attributes studied; Table 3.2 examines consumer characteristics. Although there tends to be agreement on constructs there is clearly considerable disagreement on precisely how these constructs are operationalized. Further there is little evidence of attempts to test the reliability or validity of the measures used.

Tables 3.1 and 3.2 show the same 4 underlying constructs as identified above in discussion of Demand Models (Section 2.0): cost of a trip, service provided by the transit company, journey time and automobile availability. In addition, a number of other constructs have been addressed in these consumer-oriented studies. The most commonly added variables relate to a "safety" or "privacy" construct (safety, avoiding annoying individuals, privacy, violence, control of the situation). The other common additions relate to general personality variables or beliefs (pollution levels of different modes, enjoyment of travelling with others, energy use, attitude toward transit). These factors are hypothesized to have a major impact on individual's use of transit, although few studies have found consistent results. The major problem with the use of these variables is their lack of operational implications. While a transit system may be able to change people's perceptions of safety, or pollution, or energy use, most of the other variables can explain use or non-use without providing a direction for change.

As in regression studies there is a problem in operationalizing the underlying constructs. For example Golden et al (1980) asked respondents

TABLE 3.1

ATTRIBUTES OF TRANSIT SYSTEMS

(Consumer Decision Models)

Cost of trip

- Fare (1-4, 6-13)*

Service

- Ease of use (3, 5, 6)
- On-time arrival (4, 5, 6)
- Reliability (5, 6, 7, 10)
- Convenience (1, 2, 3, 5, 6, 7, 9, 10, 12)
- Perception of availability (4, 5, 10, 12)
- Relaxing (3, 6, 7)
- "arriving as planned" (2, 4)
- Comfort (1, 2, 6, 10, 12, 13)
- Flexibility (1, 6, 10, 13)
- Location of stops (3, 12)
- Frequency (3, 12)
- Hours of service per day (8)
- Number of blocks from bus to destination (5)

Travel time

- Time waiting (2, 5, 6)
- Travel time (1, 2, 4, 6, 7, 10, 12)
- Speed (3, 13)

Privacy and safety

- Avoiding annoying individuals (2)
- Safety (1, 3, 4, 6, 8, 10)

TABLE 3.1 (cont'd.)

Privacy (1, 10)

Violence (6)

Control of situation (10)

Other attitudes and factors

Attitude toward congestion (11)

Friendly drivers (12)

Energy use, pollution (8, 10)

Package space (6)

Perceptions of transit (7)

Crowding/effort (10)

*Numbers in brackets refer to the following studies:

1. Belohlav and Shell (1980)
2. Behnam and Thomson (1976)
3. Blankenship (1976)
4. Crosby (1981)
5. Dobson et al (1978)
6. Gensch and Torres (1980)
7. Gilbert and Foerster (1977)
8. Golden et al (1980)
9. Henley et al (1981)
10. Mitchelson and Gauthier (1980)
11. Vancouver Carpool (1977)
12. Vanier and Watruba (1977)
13. Wiese (1978)

TABLE 3.2

ATTRIBUTES OF CONSUMERS IN TRANSIT RESEARCH

Demographics

- Income (1, 3, 4, 6, 8)*
- Number of cars in household (2, 4, 6, 8)
- Number of drivers licenses (6)
- Age (2, 3, 4, 8)
- Sex (1, 2, 8)
- Home ownership (1)
- Education (1, 3, 5)
- Race (4, 5)
- Occupation (4)

General

- Need for a car (10)
- Flexible working hours (7, 10)
- Like travelling with others (9, 10)
- Distance to work (2)
- Personality (5)
- Time of day of work trip (9)

*Numbers in brackets refer to the following studies:

1. Belohlav and Shell (1980)
2. Behnam and Thomson (1976)
3. Blankenship (1976)
4. Bochner and Stuart (1978)
5. Crosby (1979)

TABLE 3.2 (cont'd.)

6. Dobson et al (1978)
7. Gilbert and Foerster (1977)
8. Golden et al (1980)
9. Henley et al (1981)
10. Vancouver Carpool (1977)

to indicate what they understood by the three variables usually used to describe the service constructs, "dependability", "flexibility" and "convenience", with the following results:

dependability:	61%	- getting to destination on time
	47.8%	- available every day
	47.2%	- bus getting to your stop on time
flexibility:	51.6%	- frequency of service
	45%	- available at all hours and every day
convenience:	44%	- minimum waiting time
	41.5%	- frequent service
	36.5%	- available every day

Similarly, with variables such as cost -- are consumers looking at fares, gasoline, parking, etc., or some composite amount? Studies find that commuters consistently under-estimate the cost of travelling to work in a car, although whether researchers' estimates of actual cost of running a car are any better than the drivers' estimates is a moot point. The only sure conclusion is that while there is general agreement on the constructs of importance, both researchers and consumers evidence considerable disagreement on the details of operationalizing these constructs.

4.0 EX POST EXPERIMENTATION

Although properly controlled experiments are rarely possible in the transportation field, many transit systems have tried new programs and services with the objective of encouraging ridership. The effects of such programs give some insight to the factors affecting transit use.

The Denver Regional Transportation District (Crosby 1979) tried free transit rides outside of the rush hour. According to their surveys, the post-experiment ridership (when fares were reinstated) was up about 16%. The question which arises is whether a free fare experiment will change people's habits. More than a third of the free riders were regular transit users who had shifted their travel times to off-peak. In general the new riders were young, lower-income people with limited access to a car.

In Ottawa, the introduction of a bus pass system was carefully studied. Their findings were that the decision to purchase a pass depended on the user's week-day travel habits. Once the pass was purchased, many users took extra trips for shopping and recreation, 28% of which they indicated would previously have been taken by car or taxi. A study of the impact of the Federal Government beginning to charge for parking in Ottawa was also done (Gillan 1977). This found that the best predictor of a switch to public transit was whether the driver was able to obtain a parking spot -- cost appeared to be a very small obstacle.

Vancouver ran an extensive program to study the potential for car-pooling (Vancouver Car Pool 1977). The most interesting findings from this study were that cost is almost irrelevant for switching from solo driving to carpools. The conclusion was that positive incentives would

probably have very little impact on encouraging carpooling: but negative incentives such as increased parking costs or bus lanes might work.

The last group of studies relate to a number of issues: how much time people actually spend travelling in urban areas for all purposes; the nature of work trips; and the types of activities for which "travel" is required. People travel for a number of reasons. Pant and Bullen (1980) suggest three general breakdowns: work and organizational; personal and household maintenance; and leisure. Both these researchers, and Hanson (1980) focus on the importance of the multi-purpose trip. Their research shows that to assume a work trip constitutes a single purpose movement between home, office and home again will lead to erroneous conclusions. Particularly the home-bound work trip tends to be multi-
purpose, and as a result may require more facilities of the travel mode than a simple work trip.

5.0 CONCLUSIONS FROM LITERATURE REVIEW

The review has illustrated that there are three general approaches to the study of consumer adoption of public transit: macro-level econometric models, consumer-decision process approaches, and post-hoc experimentation. These approaches use a wide range of methodologies, and an even wider variety of variables. There are, however, some underlying themes which can be observed. In particular, the constructs which the researchers are attempting to measure can be classified in four broad categories: cost of trip, availability of an automobile, service provided, and travel time.

The implications for our research are clear. Although in a trade-off situation it is difficult to manipulate "availability of an automobile", the other three constructs appear to define the range of variables which consumers consider in the decision to use public or private transit for their journey to work. The different operationalizations of these constructs illustrated in Table 2.1 and 3.1 provide a basis for the development of our research instruments.

The next step in this project is to interview fifty users and fifty non-users of public transit who perceive that they have a choice in their transportation mode. There are two research objectives for this phase.

1. To determine what trade-offs people are willing to make in terms of cost, service and travel time, and also to determine if these trade-offs differ between users and non-users.

2. To determine whether users and non-users differ in their perceptions of the ability of public or private transit to provide levels of service, cost, or trip time.

6.0 MEASUREMENT OF COMMUTER'S TRAVEL VALUES: A FIELD TEST

The primary purpose of our research was to field test a measurement system for establishing the travel values held by commuters. In particular this measurement system was to contrast the values held by transit users and non-transit users as it was expected that they would be significantly different in orientaion. Both the implicit tradeoffs commuters would be willing to make between such factors as cost and convenience, and commuters' perceptions of transit and non-transit on these factors were expected to differ.

The field test was in the nature of a reconnaissance in force. A sufficient sample size was used to test the viability of the measurement system and to give some indication of the results that might arise from a comprehensive survey. But neither the overall sample size nor the method of sampling were sufficient for projection of the results to the community at large. Hence the results which follow should not be used in policy decisions but as a framework for evaluating this methodology and its future, full-scale application.

6.1 Methodology

6.1.1 Questionnaire

The measurement instrument was developed through several iterations of pretesting with convenience samples totalling 80 business men and women. During pretesting, questions were adjusted to improve their comprehension and precision, and items added or dropped to improve question

targeting. The questions were based on those travel factors found important in the literature review above.

The final questionnaire (Appendix 1) contained four sections. The first section measured respondents propensity to transit use by two methods, (i) behaviour in the last five work days, and (ii) Lovelock's (1973) transit interest scale. The second section comprised 40 attitude scale items. Twenty of these items concerned opinions on the Toronto Transit Commission (TTC) services. A typical item was "I can get to work on time using the TTC". Respondents were asked to respond to this stimulus on a five point scale ranging from "strongly agree" to "strongly disagree". The remaining 20 items asked the same questions with TTC replaced by car ("I can get to work on time using the car", etc.).

The third section was designed to measure the relative value respondents placed on six principal attributes of their journey to work. These six attributes were cost ($10, $25 per week); sitting room (plenty, too crowded); speed of journey (current length, 15 minutes faster): wait for service (2 minute wait, 10 minute wait); walking distance involved (door to door, 3 block walk); and reliability of service (always on schedule, have to allow leeway for delays). The levels on these attributes were chosen to provide a range of response while remaining believable. Travel scenarios were constructed by combining attributes. Each scenario contained an element from each attribute. For example, one scenario was:

cost $25/week

3 block walk at one end

2 minute wait

will take as long as your current trip

plenty of space for you to sit

you always arrive right on schedule

The two levels on each of six attributes yielded $2^6 = 64$ possible scenarios, which exceeds the number respondents can reliably handle. A subset of 16 were selected to enable all main effects and a selection of interactions to be estimated in subsequent analysis. The scenarios used are shown in Appendix 2.

Each respondent was presented with the scenarios as 16 separate cards and asked to rank order them in order of travel preference. The starting order of the cards was randomized between respondents to remove bias from presentation order. In making this rank ordering, the respondent must implicitly trade off the features of each hypothetical journey one against another. For example, does increased cost outweigh convenience and reliability? Subsequent analysis of the rank orders (described below) enables the relative values placed on these features to be estimated. In addition respondents were asked to assign points to each scenario, measuring their overall attractiveness. Respondents were instructed to assign 100 points to their most preferred scenario and fewer points to less preferred scenarios. This provided two measures of preference: a ranking (ordinal scale), and a points score (possibly an interval scale).

A second area of part three asked respondents how likely car and TTC were to take values listed in the scenarios. The fourth and final section collected respondent demographics including distance of home from work and closeness of the nearest transit stop.

6.1.2 Sample

Since the primary objective was to test methodology, a convenience sample was used. Later applications of the methodology on a comprehensive basis will, of course, require random sampling, and probably use mail interviews.

For the convenience sample an office complex was sought in Metro Toronto that would (a) proide an adequate sample size (b) provide a socio-economic range of employees and (c) provide reasonable proportions of both transit and non-transit users. These criteria were met by the offices of the Ontario Ministry of Transportation at 1201 Wilson Avenue in North York. The Ministry kindly agreed to cooperate with the study.

To maximize response, and correspondingly minimize non-response errors, a respondent incentive was employed. The incentive was a $1 lottery ticket given to respondents on return of a completed questionnaire. The lottery ticket has proved in other studies to produce more response than an equal amount of cash, and by being non-cash, is unlikely to upset a respondent's normal financial transactions during the period of the study.

Prior estimates of travel modes used in the office complex determined the sample size. It was estimated that a quarter of the office staff used transit and three-quarters private cars. A conservative estimate of survey response rate with the lottery ticket incentive was 50%. Since fifty respondents were required for each sub-sample, 400 questionnaires were distributed ($400 \times \frac{1}{4} \times \frac{1}{2} = 50$).

Self-completion questionnaires were handed to staff as they arrived at work on Thursday 29 October 1981. A covering letter explained the study (Appendix 1). Respondents were asked to complete the questionnaire

during work breaks and return it when convenient. Staff were on hand through the day to resolve problems, collect questionnaires, and hand over lottery tickets.

6.2 Results

A total of 279 questionnaires were returned, a response rate of 70%. Of these, sixty, or 21% were transit users, thus exceeding the target of fifty. An equivalent size sample of non-transit users was randomly selected from the remaining responses subject to the respondent living with access to transit. The aim of the analysis was to contrast transit users with non-users who could use transit if they chose to.

6.2.1 Questionnaire Completion

Each questionnaire was checked at return for completeness and each respondent asked about completion difficulties. Two respondents had had problems because only 15 of 16 scenario cards had accompanied their questionnaire. About a dozen respondents said the rank ordering had been difficult and another couple of dozen said it had been hard. At least an equal number of respondents volunteered that it was easy. Three respondents had omitted to complete the rank order numbers on the cards but since they had rated all scenarios on the points scale these omissions could be corrected in coding.

In other sections of the questionnaire few problems arose. A dozen respondents omitted section three (b) or four until prompted by the administrators. Half a dozen reported that completion of one or other part of section two, the attitude items, seemed irrelevant because they always took transit or always took the car.

The first question on the 1st week's travel to work mode was variously interpreted as days or trips. Some respondents also did not give a numeric answer but simply ticked the appropriate mode. Potentially, the word "TRANSIT" in the instructions to that question was biasing too.

Overall, the problem rate was low for a self-completion questionnaire and engendered confidence in future use of the instrument. Additional instructions inserted into the questonnaire would reduce the error and problem rate even further.

6.2.2 Profile of Respondents

A respondent profile is given in Table 6.2. The sample achieved nearly equal representation of men and women and a spread of age groups.

TABLE 6.2 Profile of Respondents by Mode of Travel

Description		Percents (column)		
		all	car	transit[1]
sex	male	45	54	37
	female	55	46	63
age	under 25	16	15	17
	25 - 44	54	48	60
	45 - 65	30	37	23
occupation	Professional/Managerial	39	44	33
	Clerical/Secretarial	56	53	60
	Other	45	3	7
education	high school or less	53	51	55
	some College or more	47	49	45
income	under $25,000	42	34	50
(family)	$25,000 - $39,999	45	46	45
	$40,000 and over	13	20	5
car in family	yes	87	95	78
	no	13	5	22
car of your own	yes	61	93	30
	no	39	7	70
distance to	block	50	44	55
transit stop	¼ mile	33	40	26
	over ¼ mile	17	16	19
distance from	less than 4 km	23	16	30
work	4 or more km	77	84	70

1 comprises Transit and Transit plus car.

Occupation, education, and income were above provincial averages reflecting the nature of the office. Nine tenths of households owned a car, eight tenths lived within a quarter mile of a transit stop, and three quarters lived more than 4 miles from the office.

Table 6.2 also compares the profiles of transit and car commuters.[1] Compared to car commuters, transit users are more likely to be female, younger, less educated, lower income, and less likely to have professional/managerial occupations. Their households are less likely to own a car, be closer to transit, and closer to the office. Only 30% of transit commuters had a car of their own, compared to 93% of car commuters. Although transit and car users differed in degree, it is important to note that transit draws significant patronage from all demographic groups except those with incomes exceeding $40,000 per year.

Most non-transit commuters had had experience with using transit to travel to work. Forty one percent occasionally used public transportation by choice or when they had to. Another 41% did not use it at the present time, but had used it in the past. Only 18% had never used public transportation for travel to work.

Owing to the method of comparison sample selection, namely an equal number of transit and non-transit users, it would be misleading to calculate percentages for transportation mode within demographic groups, for example the proportion of males using transit. These statistics would be available from a full scale study.

7.0 TRANSPORTATION MODE ATTITUDES AND PERCEPTIONS AND SCENARIOS

This section compares transit and non-transit users attitudes, perceptions, and scenarios, and contrasts ratings given for car and TTC. More comprehensive analysis of attitudes and perceptions is presented in section 8 and 9.

Mean scores for the attitude ratings are given in Table 7.1 The table can be used to compare (a) transit and non-transit users ratings of the same item and (b) the same question asked about TTC and car as modes of travel. Overall, 21 of the 40 ratings given by transit users were statistically significantly different from ratings given by non-transit users (at p .05). Nine of these differences exceeded half a scale interval, but only one reached one scale interval on the five point (four interval) scale. This was for the item "I would always choose TTC on a snowy day". Transit users tended to agree with this, while non-transit users tended not to agree. For the differences that were significant, non-transit users rated cars more favourably than transit users, and transit users rated transit more favourably than non-transit users. This is a normal attitude rating phenomenon, reflecting differential perceptions, halo effects (a tendency to rate all things for your team higher), or a combination of both.

The same attitude items were asked in the context of attitude toward TTC travel and attitude toward car travel. For example, respondents rated both "The TTC is there when I want it" and "The car is there when I want it". These ratings were compared within user groups yielding 20 comparisons for transit users and 20 comparisons for non-transit users. Overall 36 of the 40 comparisons were statistically significant, with 33

TABLE 7.1 Attitudes to Transportation to Work Modes

	Attitude to TTC		Attitude to Car	
	non-transit users	transit users	non-transit users	transit users
1. I can get to work on time using ...	2.9+	2.4+*	1.5	1.9*
2. I arrive at work relaxed when I use ...	3.4+	2.9*	1.9	2.6*
3. It's never too hot or cold on the ...	3.6+	3.4+	2.3	2.4
4. I never worry about my safety on the ...	2.5+	2.5+	3.2	3.5*
5. There is little effort involved in travelling by ...	3.5+	3.1	2.3	3.0*
6. The ... is there when I want it.	3.3+	3.2+	1.5	2.3*
7. I am not made uncomfortable by others when travelling by ...	3.2+	3.3+	1.8	2.3*
8. I save money travelling by ...	2.6+	2.4+	3.3	3.7*
9. There are no problems with bad weather on the ...	3.7	3.6+	3.7	4.0

	Attitude to TTC		Attitude to Car	
	non-transit users	transit users	non-transit users	transit users
10. ...gets me to work quickly.	3.7+	3.1+*	1.6	1.9*
11. There are no long waits for the ...	3.7+	3.7+	2.4	2.5
12. It is tiring travelling by ...	2.9+	3.0	3.9	3.4*
13. I'm not annoyed by loud talking or other people when travelling by ...	3.4+	3.4+	2.0	2.3
14. It is easy to walk to ...	2.5+	2.4+	1.5	1.8*
15. Overcrowding is not a problem with the ...	4.0+	4.0+	1.7	2.0
16. I don't worry about traffic accidents with the ...	2.6+	2.6+	3.3	3.9*
17. I can control my own environment with the ...	3.7+	3.4*	1.8	2.1*
18. I would always choose ... on a snowy day.	3.5+	2.5+*	2.8	3.6*
19. It is inexpensive to travel to work by ...	2.8+	2.7+	3.3	3.8*
20. It takes too long to travel to work by ...	2.3+	3.0+*	4.4	3.9*

TABLE 7.1 (cont'd.)

Notes: 1. Mean scores where (1) = Strongly Agree
(5) = Strongly Disagee

2. * For this item, the difference between transit and non-transit users is statistically significant at p .05.

3. + For this item the differences between attitudes toward TTC and attitudes toward cars are statistically significant at p .05.

exceeding half a scale interval, and 26 equalling or exceeding a scale unit. Most of these comparisons favour car over TTC. The exceptions are the four items concerned with cost and safety, for which the TTC is favoured, and the item "I would always choose TTC (car) on a snowy day". For this latter item, transit users preferred transit, and non-transit users preferred car.

The mean scores for perceptions are given in Table 7.2 in a similar manner to the attitude ratings data. The transit and non-transit users differ in their perceptions of transportation modes in six of thirteen evaluations. The principal differences were in relation to perceptions of TTC travel. Transit users perceived the TTC to be more spacious, faster, less waiting, more on schedule, and less likely to require a 3 block walk than did non-transit users. The differences range from .5 to .9 scale intervals on a five point (four interval) scale.

The scenarios listed in Appendix 2 show the average number of points (and the consequent ranking) allocated to them by respondents. The points were remarkably consistent between transit and non-transit users. For only one of the scenarios were the points allocated statistically significantly different (p .05 level). Since there were 16 scenarios, this is the number of "significant" results one could expect by chance. The dominance of price is indicated by the way in which only one of the eight $25 cost alternatives is in the first eight choices of the 16 scenarios.

Appendix 3 lists the verbatim responses to part 4 question 9. They are not further analyzed but are included for completeness.

TABLE 7.2 Perceptions of Transportation to Work Modes

	Perception of TTC		Perception of Car	
	non-transit users	transit users	non-transit users	transit users
To cost $10 per week	2.5	2.8	2.7	2.9
To cost $25 per week			3.5	3.1
To have plenty of space for you to sit	3.5+	2.9+*	1.0	1.3*
To be 15 minutes faster than your current trip	4.8+	3.9+*	2.1	1.7
To require a 10-minute wait	2.0+	2.5+*	4.4	4.2
To need a 3-block walk at one end	2.4+	3.1+*	4.7	4.6
To always get you to work right on schedule	3.5+	2.6+*	1.5	1.9

Notes: 1. Mean scores, where (1) = very likely, (5) = not at all likely.

2. * For this item, the difference between transit and non-transit users is statistically significant at p .05.

3. + For this item, the differences between perceptions of TTC and perceptions of car are statistically significant at p .05, for the user group (TTC or car) shown.

8.0 FACTOR ANALYSIS OF TRANSPORTATION MODE RATINGS

Respondents rated Public Transit and Automobile as methods of getting to work on 20 Likert-scale items (Appendix 1 page 3 and 4). Factor analysis of these items produced 5 interpretable factors, explaining over 68% of the variance in the original items.

Factor analyses were conducted using a) only the public transit ratings, b) only automobile ratings, c) only individuals using public transit for their journey to work, d) only individuals using automobiles for their journey to work. The four or five significant factors extracted were almost identical in all cases. The factor structure was clearly robust. Interestingly, when factor analyzing pooled data for both automobile and pulic transit ratings (as reported in Table 8.1) only three factors had eigen values greater than 1, i.e. only three factors contributed significantly to explaining variance in the original items. However, as four or five factors had significant effects in all the other analyses it was decided to extract, and rotate, five factors.

Table 8.2 shows the factor loadings after varimax rotation. The most important factor is Factor 1, this alone explains 22% of the variance in the original 20 rating scales. Factor 1 is closely associated with:

Var. 1 "I can get to work on time with _____".

Var. 2 "I arrive at home relaxed when I use the _____".

TABLE 8.1 Factor Analysis of Likert Items

FIVE FACTOR SOLUTION VARI-20 ALL

INITIAL FACTOR METHOD: PRINCIPAL AXIS

PRIOR ESTIMATES OF COMMUNALITY:

VARI	VAR2	VAR3	VAR4	VAR5	VAR6	VAR7
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
VAR8	VAR9	VAR10	VAR11	VAR12	VAR1	VAR14
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
VAR15	VAR16	VAR17	VAR18	VAR19	VAR20	
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	

	1	2	3	4	5
EIGENVALUES	7.465920	3.205448	1.165942	0.971766	0.841100
PORTION	0.373	0.160	0.058	0.049	0.042
CUM PORTION	0.373	0.534	0.592	0.640	0.683

	6	7	8	9	10
EIGENVALUES	0.752715	0.681713	0.636303	0.616146	0.545562
PORTION	0.038	0.034	0.032	0.031	0.027
CUM PORTION	0.720	0.754	0.786	0.817	0.844

	11	12	13	14	15
EIGNVALUES	0.484243	0.424643	0.373604	0.338845	0.326363
PORTION	0.024	0.021	0.019	0.017	0.016
CM PORTION	0.868	0.890	0.908	0.925	0.942

	16	17	18	19	20
EIGENVALUES	0.307972	0.256920	0.233275	0.213127	0.158394
PORTION	0.015	0.013	0.012	0.011	0.008
CUM PORTION	0.957	0.970	0.981	0.992	1.000

5 FACTORS WILL BE RETAINED.

Var. 20 "It takes too long to travel to work by _____".
(negative loading)

Var. 10 "_____ gets me to work quickly".

Var. 6 "The _____ is there when I want it".

Var. 5 "There is little effort involved in travelling".

Var. 12 "It is tiring travelling by _____".

Var. 14 "It is easy to walk to _____".

Var. 11 "There are no long waits for the _____".

Factor 1 is a measure of the extent to which a transportation mode is "QUICK and EASY".

The second most important factor is Factor 5, by itself this explains 18% of the variance in the original 20 items. Factors 1 and 5 together explain 40% of the variance in the original ratings. Factor 5 is closely associated with:

Var. 7 "I am not made uncomfortable by others when travelling by _____".

Var. 13 "I'm not anoyed by loud talking or other people when travelling by _____".

Var. 15 "Overcrowding is not a problem with the _____".

Var. 17 "I can control my own environment with the _____".

Factor 5 is less strongly associated with:

Var. 11 "There are no long waits for the ___".

and Var. 14 "It is easy to walk to _____".

although these variables seem better represented in Factor 1.

TABLE 8.2 Factor Loadings

FIVE FACTOR SOLUTION VAR1-20 ALL

ROTATION METHOD: VARIMAX

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5
VAR1	0.77711	0.13388	-0.13320	-0.06199	0.26840
VAR2	0.76815	0.06594	0.04632	0.26310	0.22200
VAR3	0.28319	-0.16975	-0.25640	0.44109	0.39202
VAR4	0.05935	0.86105	0.14224	0.19252	-0.02584
VAR5	0.57629	0.23289	0.08044	0.34467	0.21260
VAR6	0.61236	-0.01255	-0.11029	-0.017718	0.45856
VAR7	0.32223	0.06647	0.08287	0.09123	0.75661
VAR8	-0.09234	0.22562	0.87199	0.05098	-0.13133
VAR9	-0.07309	0.32217	0.20924	0.70909	0.30665
VAR10	0.75252	-0.15767	-0.10179	0.13159	0.41067
VAR11	0.46681	-0.06190	-0.01730	0.23108	0.52509
VAR12	-0.49873	0.05391	-0.23694	-0.16549	-0.39522
VAR13	0.22413	0.03373	-0.18773	0.03914	0.74444
VAR14	0.48777	0.16002	-0.03866	-0.13046	0.50760
VAR15	0.36110	-0.09170	-0.20984	0.06645	0.72425
VAR16	-0.05892	0.84064	0.28300	0.10845	0.00581
VAR17	0.44212	-0.12629	-0.31164	0.16586	0.59176
VAR18	0.35633	0.23074	0.11868	0.69469	-0.15299
VAR19	0.04012	0.19342	0.84931	0.11969	-0.12895
VAR20	-0.77275	0.25904	0.06096	-0.11631	-0.26192

ORTHOGONAL TRANSFORMATION MATRIX

	1	2	3	4	5
1	0.72948	-0.02819	-0.13842	0.21686	0.63315
2	0.09451	0.65769	0.62995	0.39463	-0.07705
3	-0.52851	0.50175	-0.46551	0.12824	0.48557
4	-0.04634	0.13233	0.41700	-0.79272	0.42296
5	-0.42125	-0.54533	0.43979	0.39037	0.42352

VARIANCE EXPLAINED BY EACH FACTOR

FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5
4.478603	1.953149	1.999424	1.608298	3.610702

Factor 5 is a measure of the extent to which a transportation mode allows a respondent to be "ON YOUR OWN".

The third most important factor is Factor 3, explaining 10% of the variance in the original items. This Factor is closely associated with:

Var. 8 "I save money travelling by _____".

Var. 19 "It is inexpensive to travel to work by _____".

Factor 3 clearly measures the extent to which a transportation mode is "INEXPENSIVE".

The last two factors in order of importance are Factors 2 and 4, these explain 10% and 8% respectively. Factor 2 is associated with:

Var. 4 "I never worry about safety on the _____".

Var. 16 "I don't worry about traffic accidents with the _____".

Factor 2 clearly measures the extent to which a transportation mode IS "SAFE".

Factor 4 is associated with:

Var. 9 "There are no problems with bad weather on the _____".

Var. 18 "I would always choose _____ on a snowy day".

and to a lesser extent with:

Var. 3 "It's never too hot or too cold on the _____".

Factor 4 measures the extent to which a transportation mode is "GOOD FOR BAD WEATHER". This factor is the least important in explaining

individuals' ratings of modes.

As discussed above, this five factor structure is highly stable across changes in sample composition (working as well for transit and non-transit users) and across transportation modes (working for ratings of both automobile and TTC). This is not unusual. In most marketing applications one factor structure has been found suitable no matter what brand the respondent prefers, or what brand they are rating. This factor structure provides a parsimonious description of respondents transit mode ratings. In particular we can plot average ratings of automobile and TTC on the five factors, for all respondents or for any chosen subset. These perceptual maps provide a ready summary of respondents' views of transportation modes.

8.1 Perceptual Maps

The first set of maps (Map 8.1 - 8.10 at the end of this section) shows the perceptions which three groups of travellers, car users, transit users, and users of both modes, have of travel to work by automobile or the TTC. The maps are presented in order of the importance of the factors in accounting for variance in the population. These factors, and the amount of variance explained (see discussion above) are: factor 1 "Quick and Easy" (22%); factor 5 "On Your Own" (18%); factor 3 "Inexpensive" (10%); factor 2 "Safe" (10%); and factor 4 "Good for Bad Weather" (8%). The scaling of the variables for this analysis results in high <u>negative</u> positions on the maps being the <u>most</u> desirable.

The first map (8.1) shows a plot of "Quick and Easy" versus "On Your Own" for the 3 groups and two modes. It is clear that the car users have

quite different perceptions of the TTC and Auto on the "Quick and Easy" dimension. The TTC is perceived to be very negative on this attribute relative to the car, at least for those who travel by car. Those who travel by TTC, or use both modes do not perceive large differences along this "Quick and Easy" dimension. Howevr, people who use the TTC for all or part of their trip see a fairly large difference between the TTC and an automobile along the "On Your Own" dimension. Not surprisingly the automobile is perceived more favourably along this dimension by all three groups.

The next map (8.2) shows "Quick and Easy" versus "Inexpensive". Here there is general agreement that it is less expensive to travel to work by the TTC than by car. The third map (8.3) shows "Quick and Easy" versus "Safety". Once again there is general agreement that the TTC is a safer way to travel to work than an automobile. The widest spread in perceptions on this "Safety" dimension is held by those who use both the TTC and an automobile in their journey to work. The fourth (8.4) map shows "Quick and Easy" versus "Good for Bad Weather". Here those who use the TTC for part or all of their journey perceive it as a good mode for bad weather, relative to the automobile. Automobile users, on the other hand, perceive their cars to be better for bad weather travel than the TTC. It is interesting that this is the only dimension on which the ordering of the two modes differs by user categories.

Map 8.10 shows a plot of "Safety" versus "Good for Bad Weather". One might have expected that these two factors would have consistency in perceptions since it is during bad weather that most accidents happen. However, this map shows strong agreement on the relative safety of autos and TTC, but quite a spread on the "Good for Bad Weather" dimension. This

might indicate potential for the TTC to connect bad weather and safety more strongly in people's minds.

The remaining maps (Map 8.5 - Map 8.9) show different combinations of the five factors. Because the relative perceptions of the modes along each factor do not change, these maps present no new insights and are included for completeness only; they will not be analyzed in depth.

MAPS 8.1 TO 8.10

PERCEPTUAL MAPS BASED ON FACTOR ANALYSIS OF ATTITUDE SCALES

KEY TO MAPS

1. Users of Automobiles
2. Users of TTC
3. Users of Both

e.g. 1 TTC is average factor score for the TTC by Auto Users

1 Auto is average factor score for the automobile by Auto Users

2 TTC is average factor score for the TTC by TTC Users

2 Auto is average factor score for the Auto by TTC Users.

S T A T I S T I C A L A N A L Y S I S S Y S T E M

----------MODE=1 GP=1----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
1	0.852549	-0.45816	-0.28021	0.0497225	0.252412

----------MODE=1 GP=2----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
2	-0.71228	0.166067	0.181506	-0.13036	-0.59561

----------MODE=2 GP=1----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
3	0.201336	-0.36808	-0.37829	-0.41691	0.619468

----------MODE=2 GP=2----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
4	-0.075858	0.224147	0.26946	-0.0036663	-0.83947

----------MODE=3 GP=1----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
5	-0.019564	-0.61019	-0.24855	-0.13707	0.786763

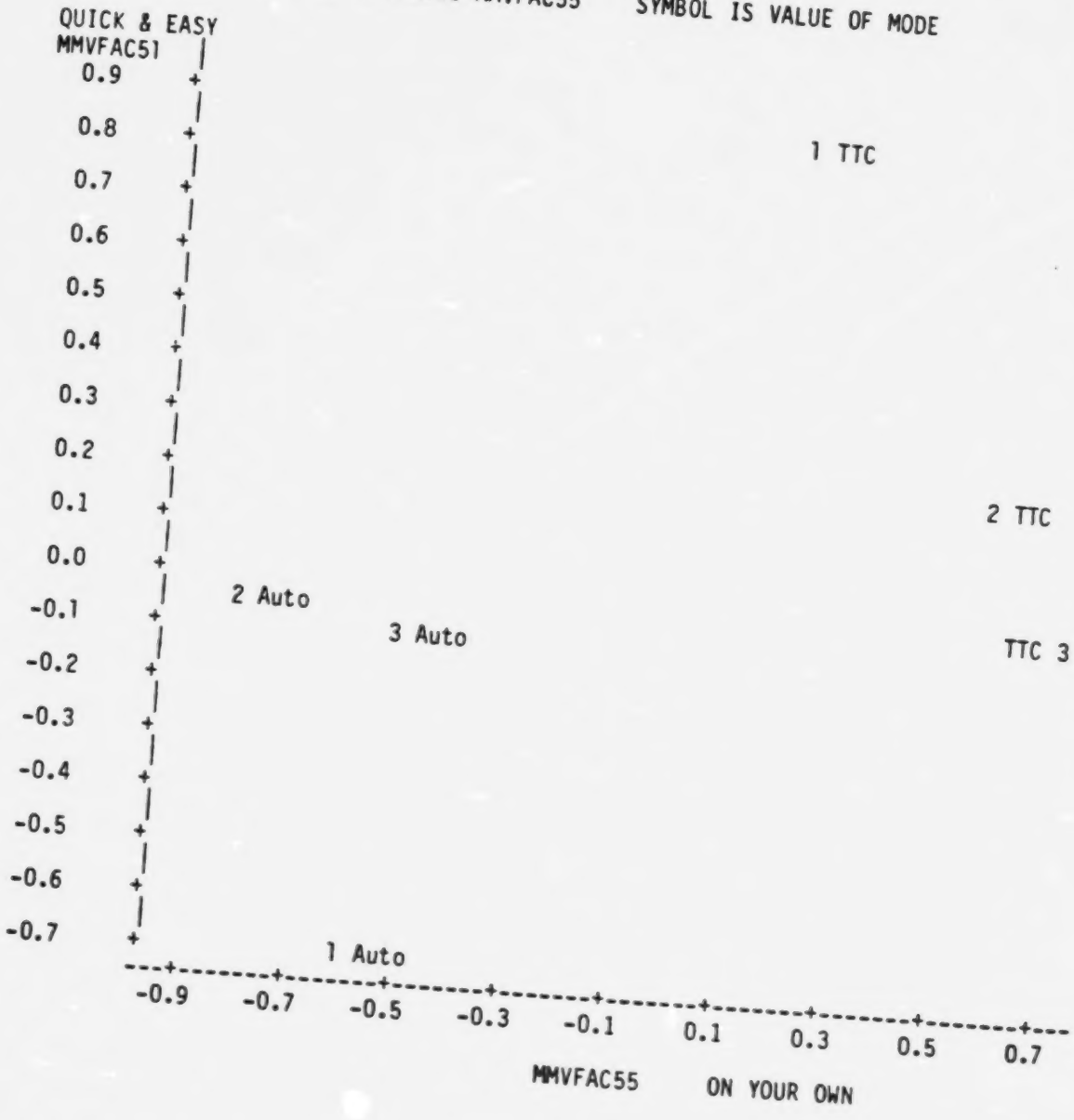
----------MODE=3 GP=2----------

OBS	MMVFAC51	MMVFAC52	MMVFAC53	MMVFAC54	MMVFAC55
6	-0.088051	0.479875	0.550658	-0.030414	-0.51631

MAP 8.1

PLOT OF MEAN FACTOR SCORE BY MODE5

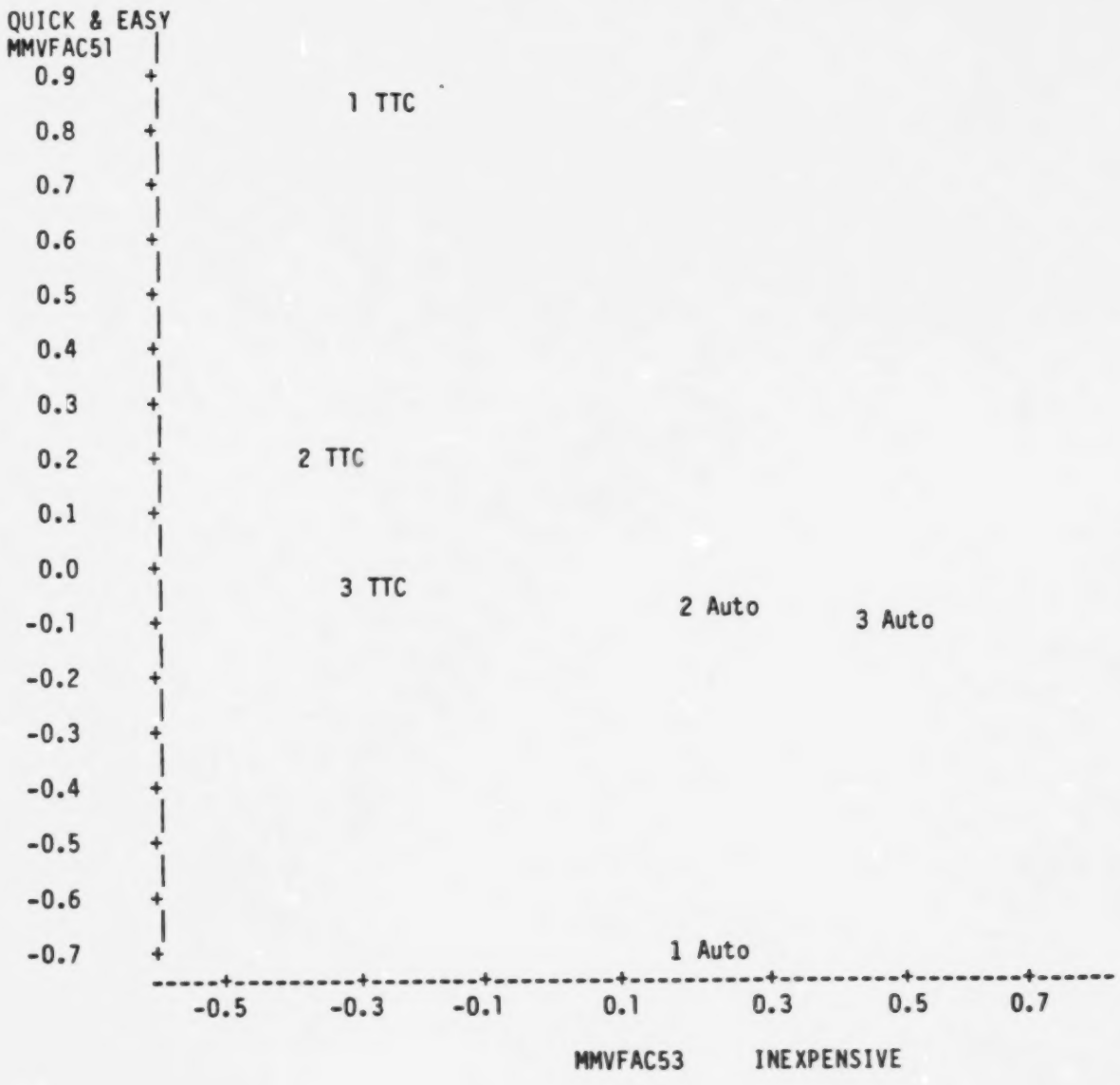
PLOT OF MMVFAC51*MMVFAC55 SYMBOL IS VALUE OF MODE



MAP 8.2

PLOT OF MEAN FACTOR SCORE BY MODE

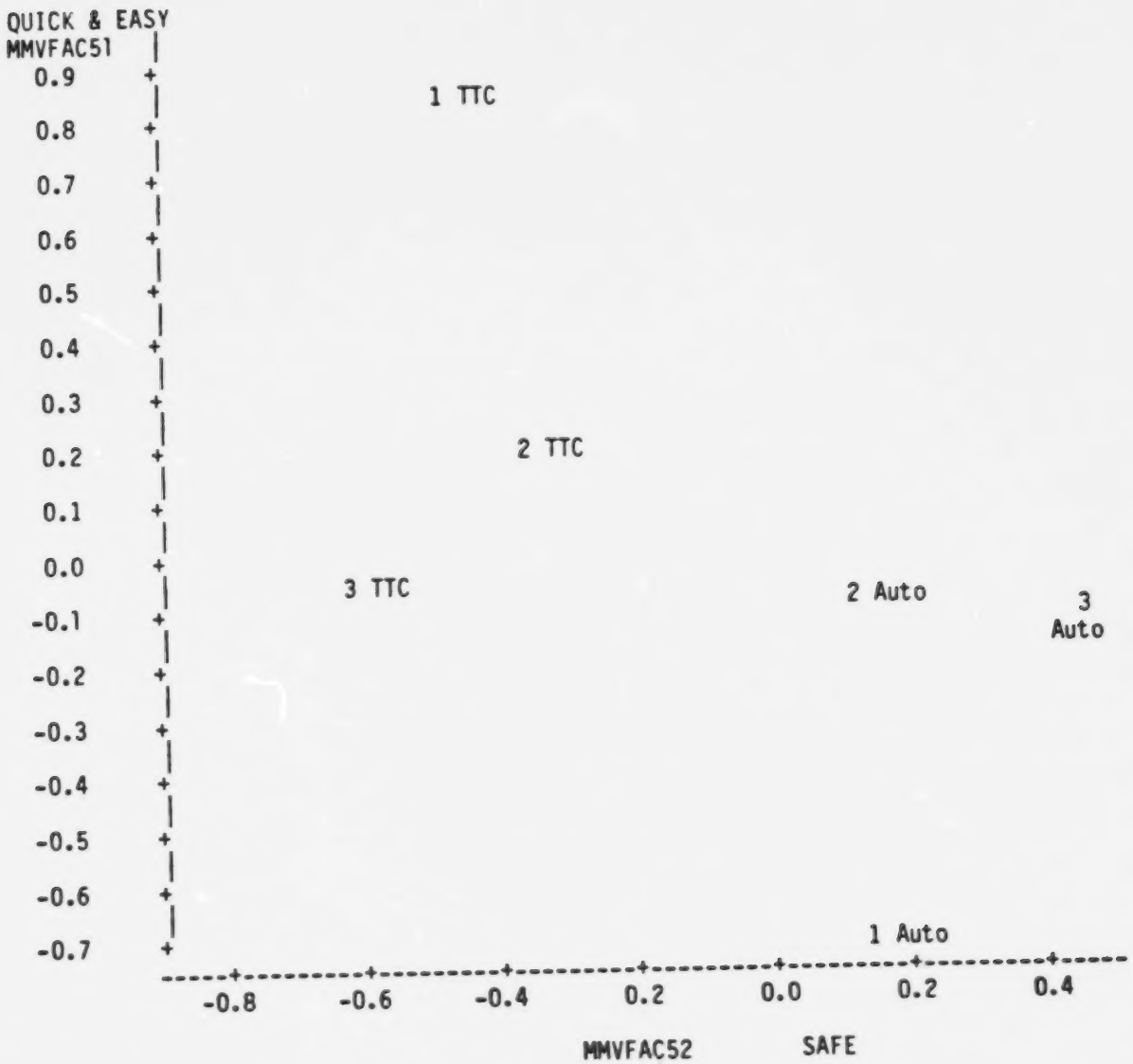
PLOT OF MMVFAC51*MMVFAC53 SYMBOL IS VALUE OF MODE



MAP 8.3

PLOT OF MEAN FACTOR SCORE BY MODE

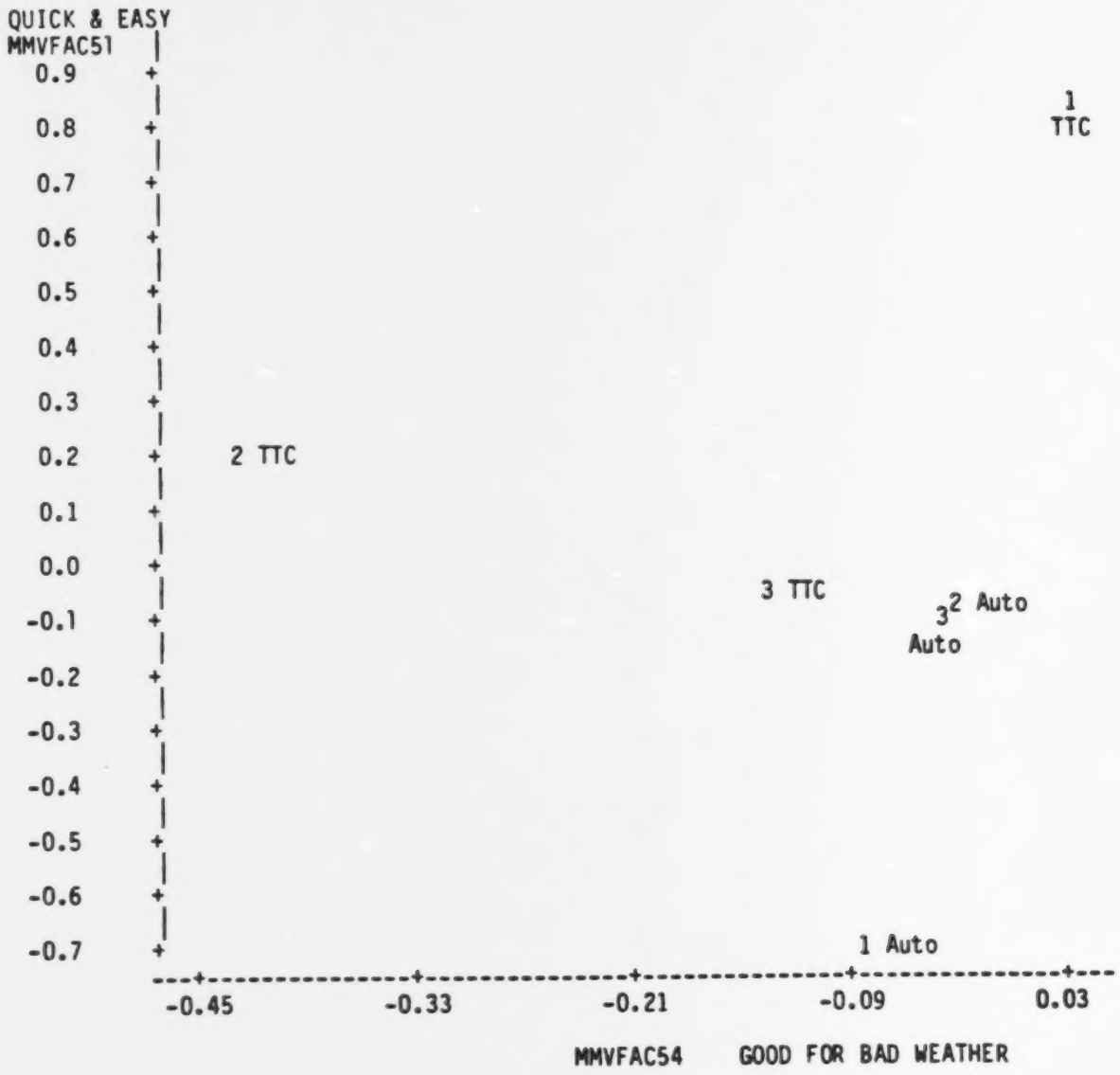
PLOT OF MMVFAC51*MMVFAC52 SYMBOL IS VALUE OF MODE



MAP 8.4

PLOT OF MEAN FACTOR SCORE BY MODE

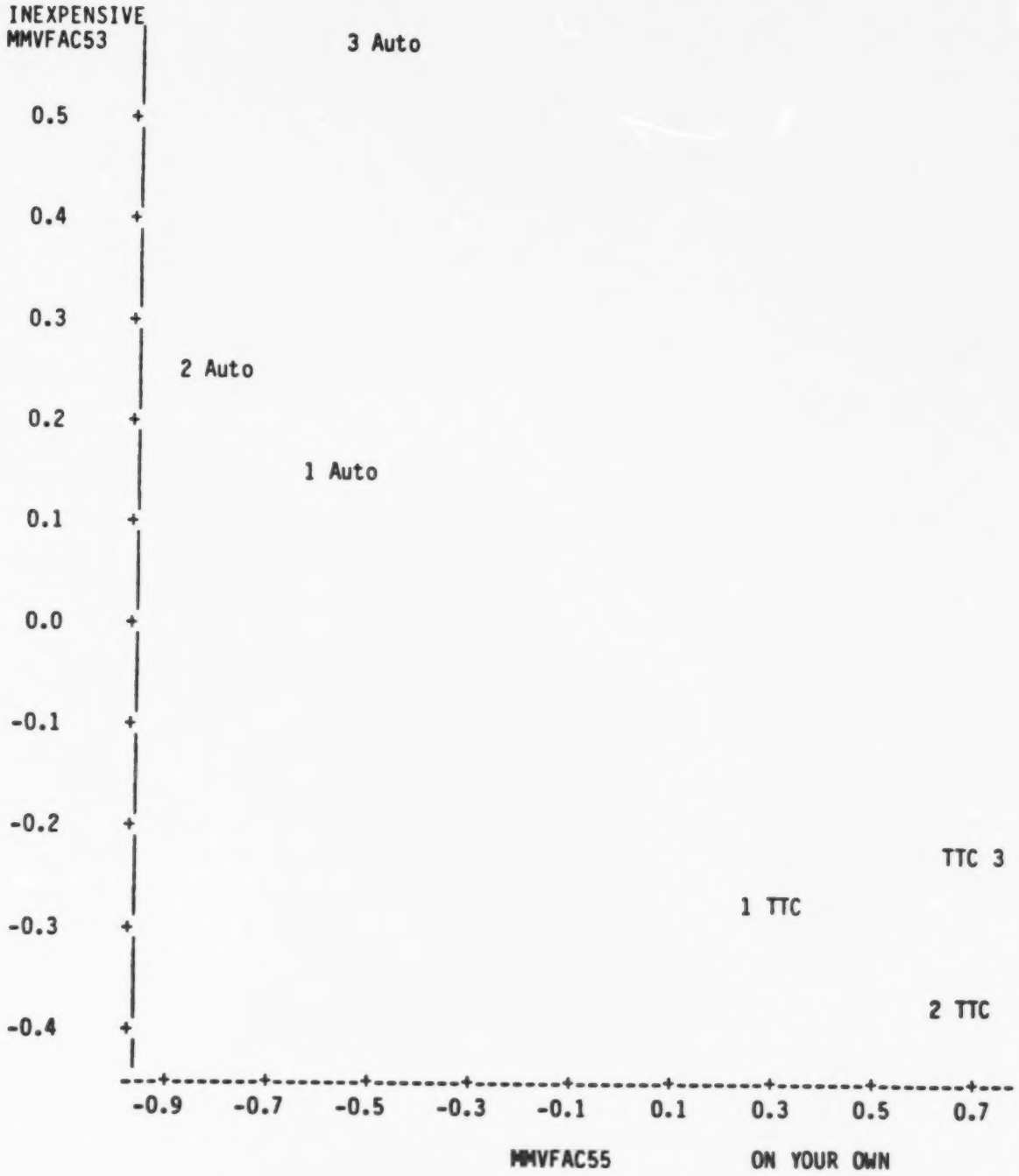
PLOT OF MMVFAC51*MMVFAC54 SYMBOL IS VALUE OF MODE



MAP 8.5

PLOT OF MEAN FACTOR SCORE BY MODE

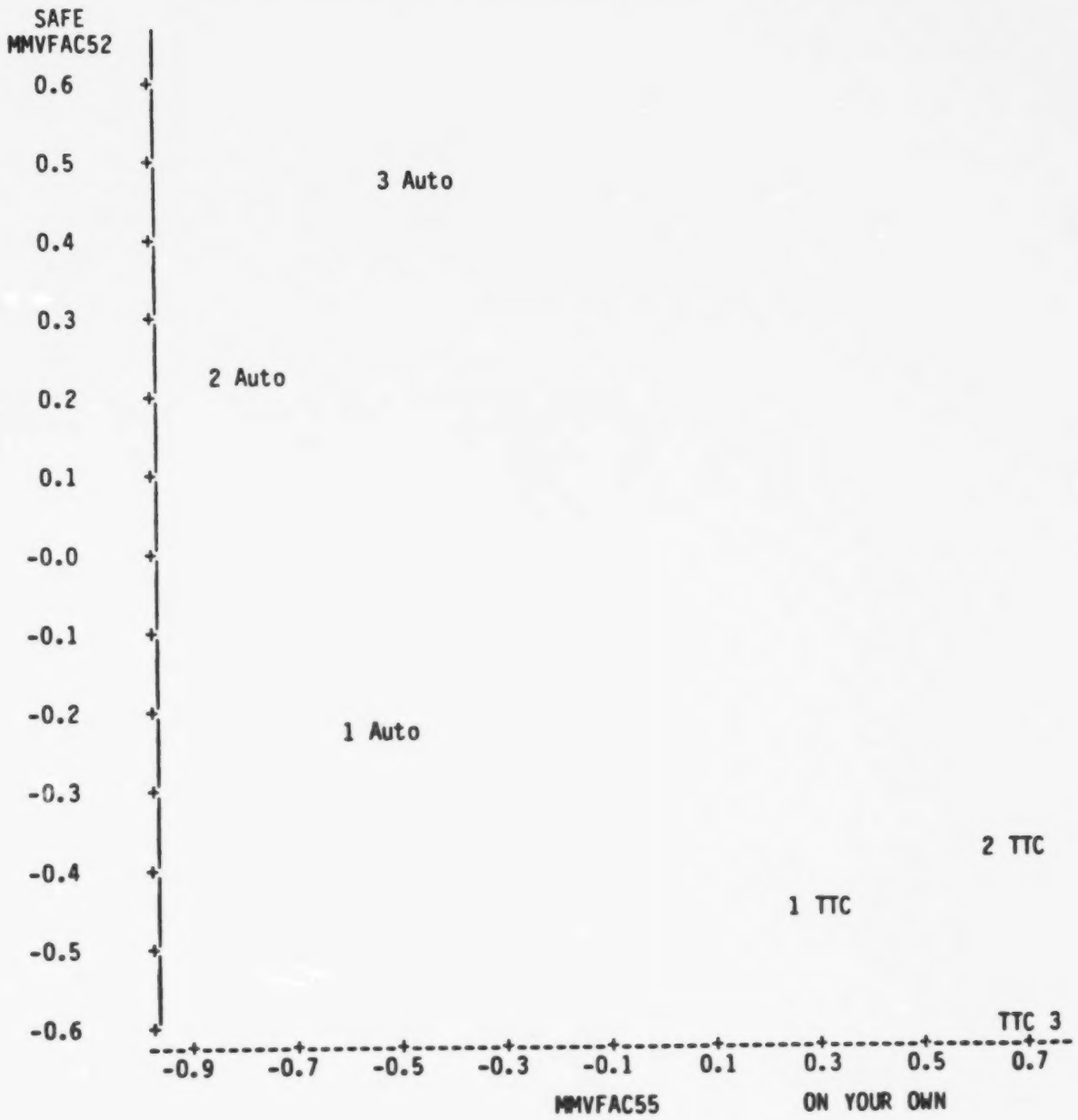
PLOT OF MMVFAC53*MMVFAC55 SYMBOL IS VALUE OF MODE



MAP 8.6

PLOT OF MEAN FACTOR SCORE BY MODE

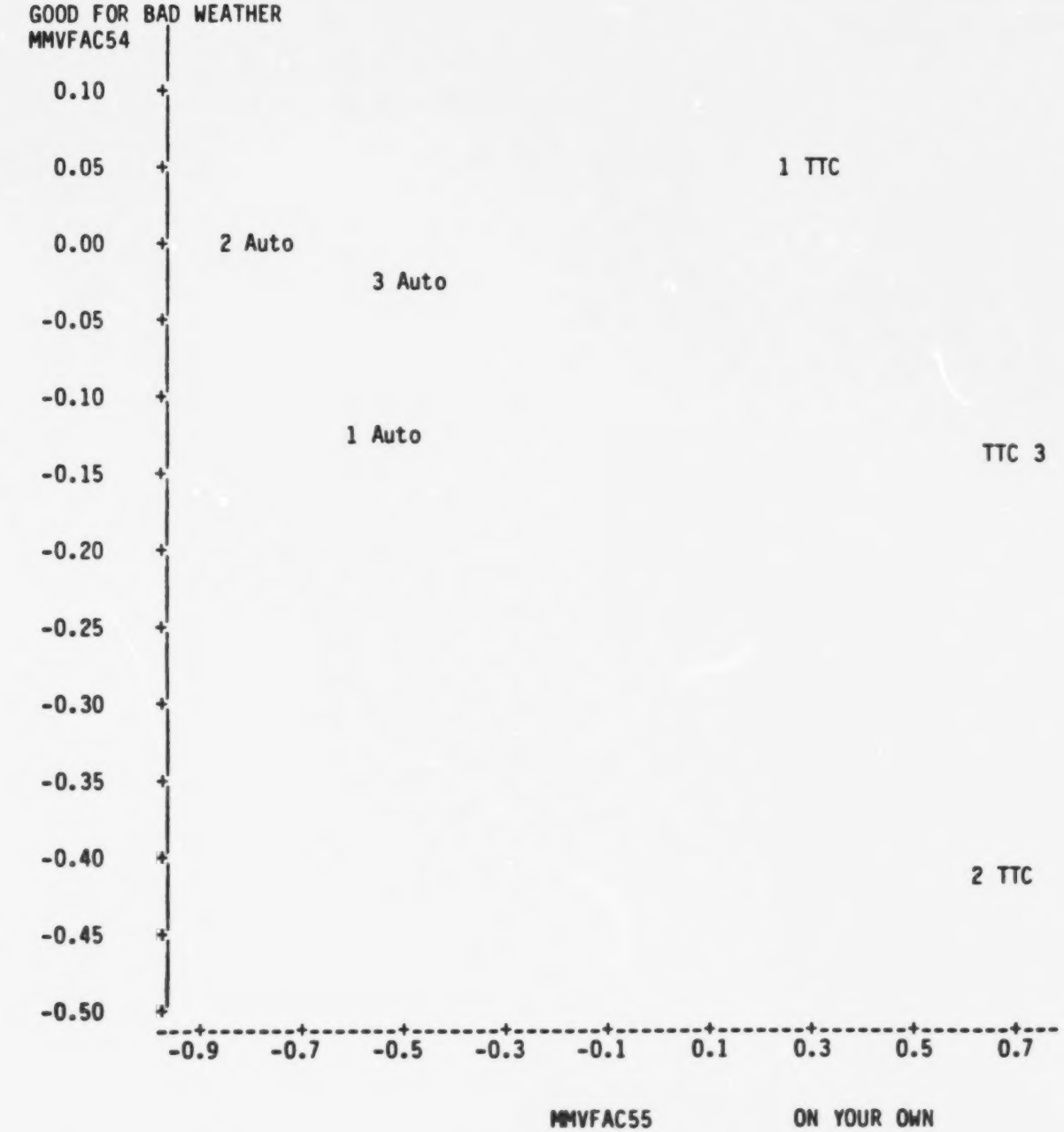
PLOT OF MMVFAC52*MMVFAC55 SYMBOL IS VALUE OF MODE



MAP 8.7

PLOT OF MEAN FACTOR SCORE BY MODE

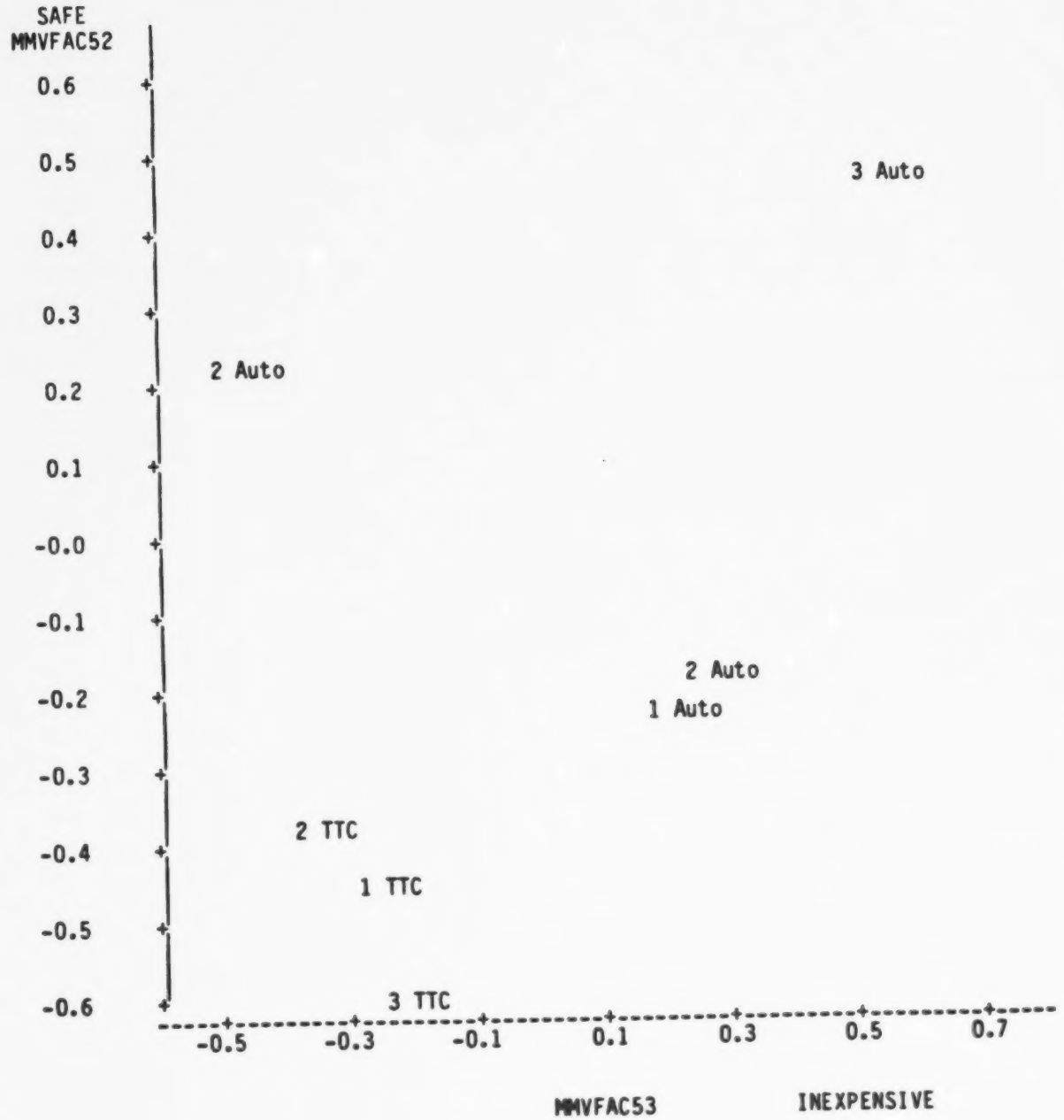
PLOT OF MMVFAC54*MMVFAC55 SYMBOL IS VALUE OF MODE



MAP 8.8

PLOT OF MEAN FACTOR SCORE BY MODE

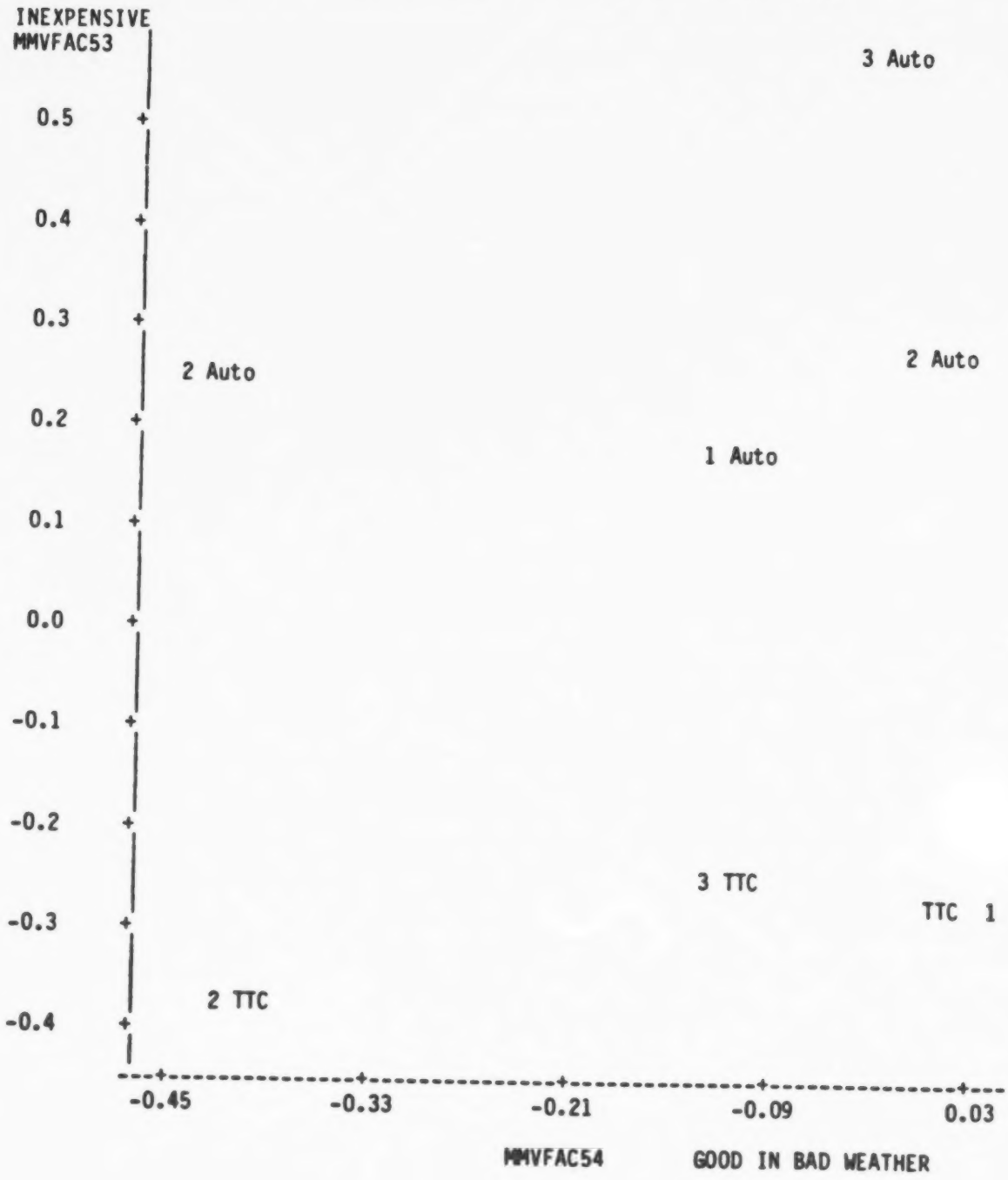
PLOT OF MMVFAC52*MMVFAC53 SYMBOL IS VALUE OF MODE



MAP 8.9

PLOT OF MEAN FACTOR SCORE BY MODE

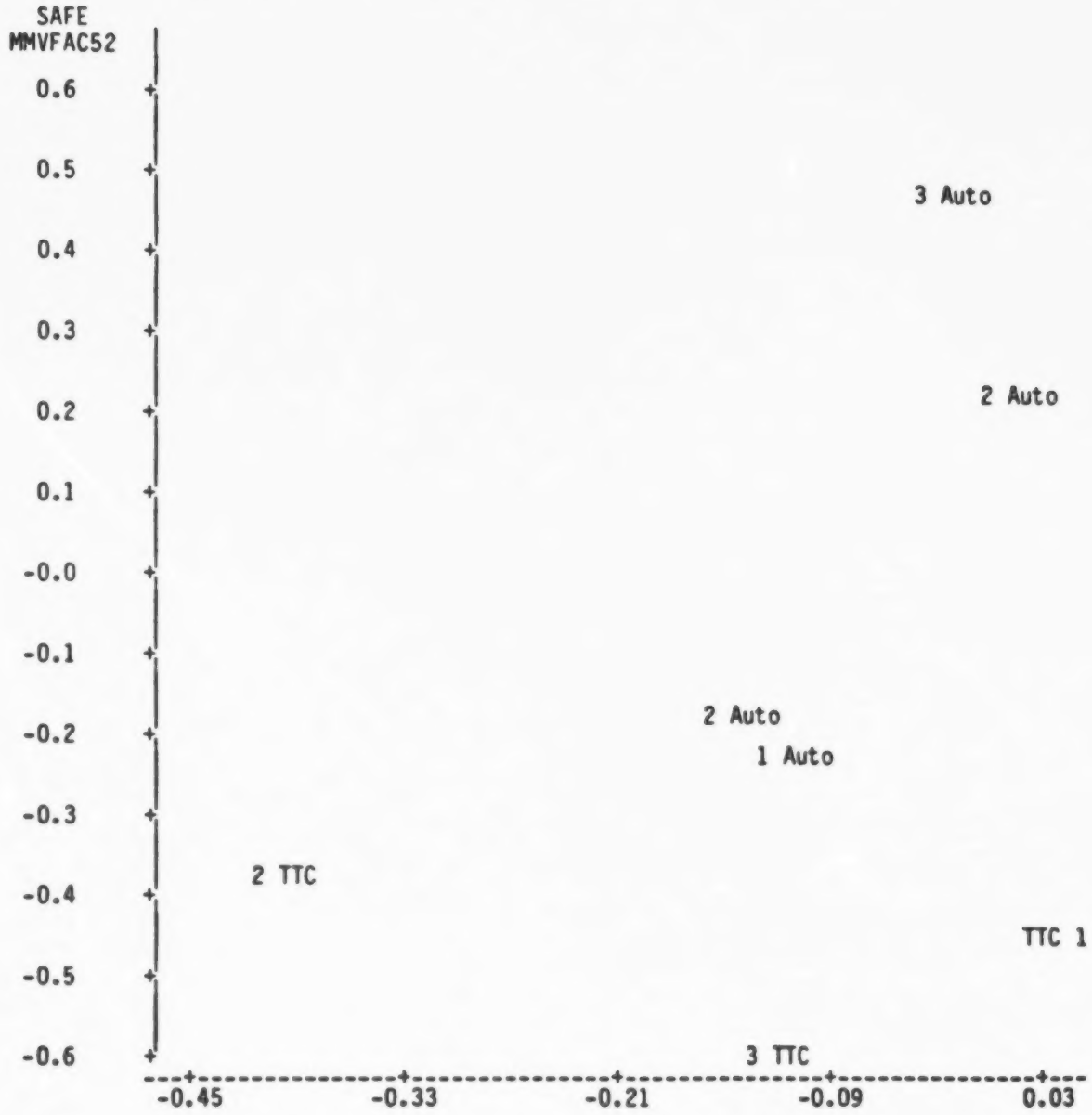
PLOT OF MMVFAC53*MMVFAC54 SYMBOL IS VALUE OF MODE



MAP 8.10

PLOT OF MEAN FACTOR SCORE BY MODE

PLOT OF MMVFAC52*MMVFAC54 SYMBOL IS VALUE OF MODE



9.0 CONJOINT ANALYSIS OF SCENARIO PREFERENCE DATA

Conjoint analysis is a methodology designed specifically for the study of multifactor alternatives. Respondents are asked to evaluate a number of product or service alternatives which differ on a number of characteristics such as price, service, comfort, etc. By varying the presence or absence, or level of a characteristic (e.g. high service level, low price) according to a statistical design, we are able to study people's tradeoffs between these characteristics. Through this technique we are able to go beyond the typical market research approach (e.g. Do you prefer a low or a high price?) to a situation where respondents are forced to decide how much more they are willing to pay for higher levels of service, or how much comfort they are willing to give up for a lower price.

The conjoint analysis portion of our questionnaire included six characteristics each at two levels (see Table 9.1 for design). Each respondent was asked to rank order 16 cards, each containing a description of a "trip to work". The statistical model takes the form:

R_{im} = rank individual i gives to trip (card) m

$$R_{im} = U_{i1}(\text{price}) + U_{i2}(\text{proximity}) + U_{i3}(\text{length of trip}) + U_{i4}(\text{on-time arrival}) + U_{i5}(\text{waiting time}) + U_{i6}(\text{comfort})$$

Dummy variable regression was used to calculate these utilities. One of the benefits of conjoint analysis is that the U_i's in the equation above can be plotted for each attribute, giving a pictorial representation of the "utility" or value to the individual of having each level of each attribute. By convention, the utility of the "best" trip

TABLE 9.1 DUMMY VARIABLES

1	1	1	1	1	1
1	1	1	0	0	0
1	1	0	1	0	0
1	1	0	0	1	1
1	0	1	1	0	0
1	0	1	0	1	1
1	0	0	1	1	1
1	0	0	0	0	0
0	1	1	1	0	1
0	1	1	0	1	0
0	1	0	1	1	0
0	1	0	0	0	1
0	0	1	1	1	0
0	0	1	0	0	1
0	0	0	1	0	1
0	0	0	0	1	0
1=$25	1=door to door	1=2 minute wait	1=15 min. faster	1=space	1=on schedule
0=$10	0=3 block walk	0=10 minute wait	0=same	0=crowded	0=delays

is assigned the value "I" and the utility of the "worst" trip is given the value "0". A study of the utility of each characteristic makes it clear which changes in product or service design would have the most impact on changing people's preferences for the product.

9.1 Conjoint Results

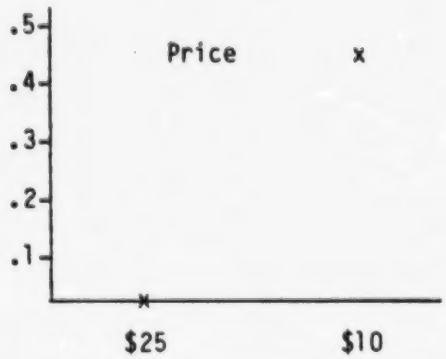
Maps 9.1 - 9.3 show the average conjoint utilities for the six characteristics estimated for automobile users, transit users, and users of both modes. The average regression coefficients from which these utilities are calculated are shown in Table 9.2.

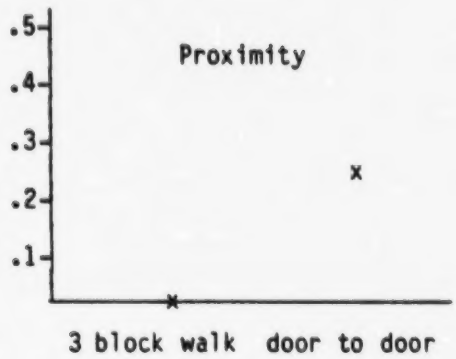
Looking at maps 9.1 - 9.3 it is clear that there are remarkable similarities in the tradeoffs all three groups are willing to make. For all three, price is the most important characteristic (utility .40 for car users, .39 for TTC users and .52 for users of both modes), although clearly more important to dual users than either of the other groups. This finding, allied with the lower importance of comfort to the dual user (utility .17 for car users, .14 for transit users and .06 for dual users) as well as slightly lower utility for decreased waiting time indicates they are willing to put up with a lot to avoid price increases. For the other variables, the three groups are in general agreement: proximity of the mode to origin/destination is second in importance, and speed and on-time arrival are least important. TTC users have a higher utility for on-time arrival than car users (.09 versus .03), perhaps indicating higher salience of this variable to that group.

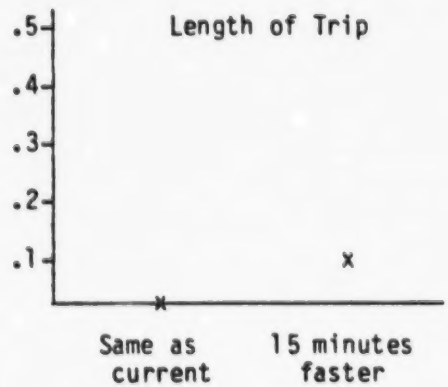
MAP 9.1

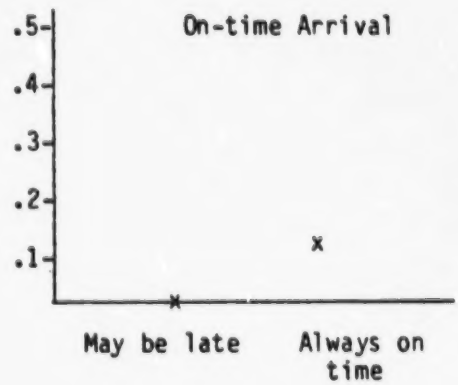
CONJOINT UTILITY MAP

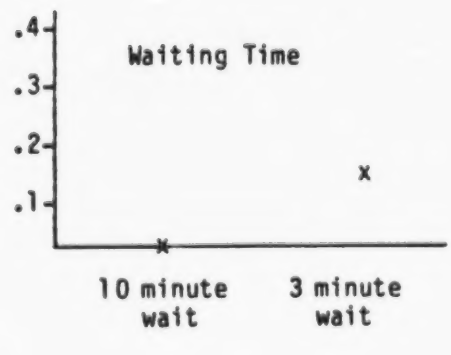
Automobile Users

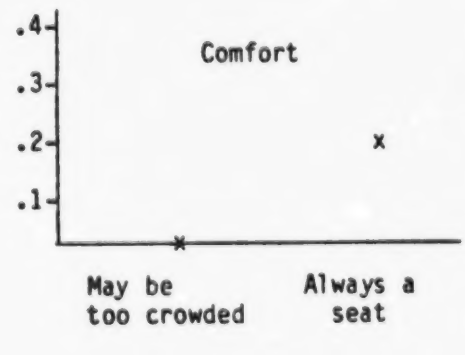








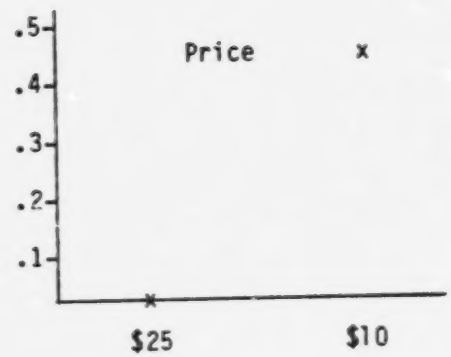


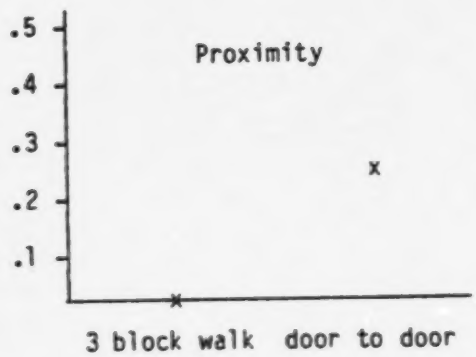


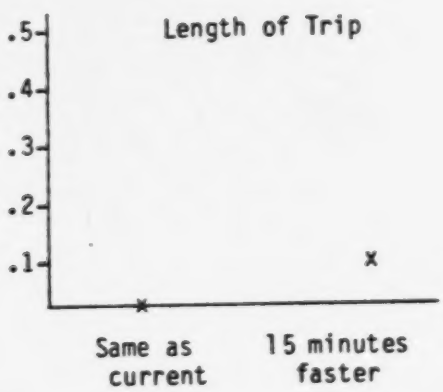
MAP 9.2

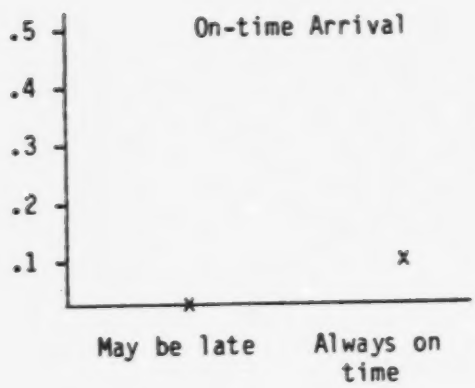
CONJOINT UTILITY MAP

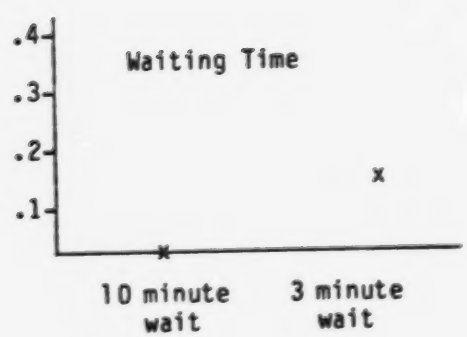
TTC Users

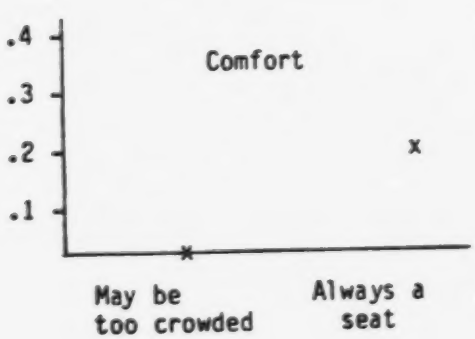












MAP 9.3

CONJOINT UTILITY MAP

Users of both Auto & TTC

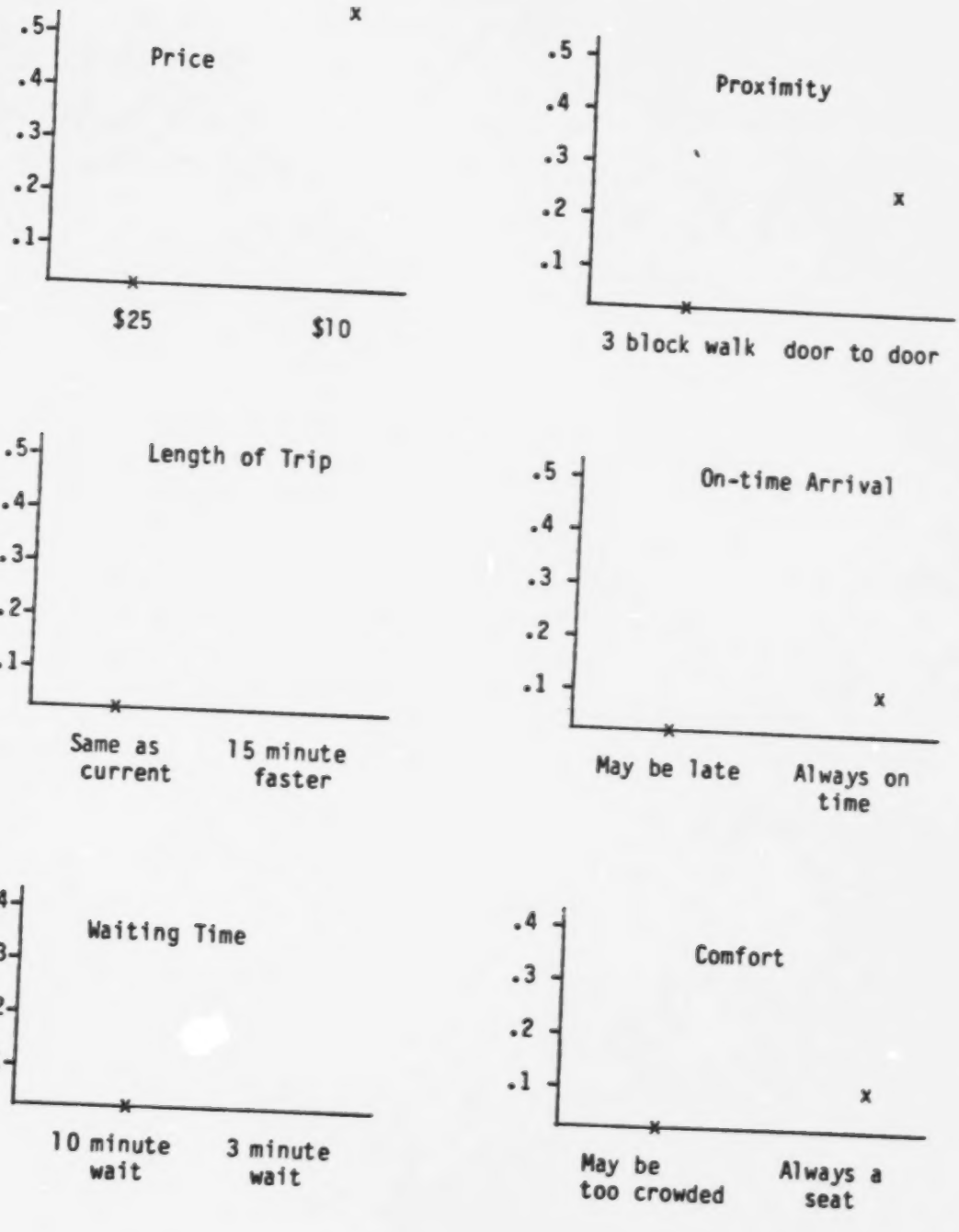


TABLE 9.2 Conjoint Utilities by Mode and User Classification

	Car	TTC	Both
Price	.40	.39	.52
Proximity	.23	.20	.22
Faster	.04	.06	.05
On Time	.03	.09	.06
Wait	.13	.12	.09
Crowded	.17	.14	.06

9.2 Individual Conjoint Results

The objective of this research is to use conjoint analysis to derive part-worth utility values for the characteristics of a trip to work. The results in the last section were based on averaging over members of three segments: automobile users, transit users, and users of both modes. The analysis can also be done on an individual basis. Individuals who display similar patterns of utilities can then be clustered to discover if there are any characteristic-based clusters of interest. In order to illustrate this approach, the following preliminary clustering analysis has been undertaken.

A hierarchical clustering routine was performed on the two sets of individual utilities: those derived using the rank orders, and those derived using the points (100 for the best "trip", etc.). For illustrative purposes, the output from the clustering on rank orders is included (Table 9.3). Although there appear to be some viable clusters in the rank order cluster output (9.3), the clustering on scores does not result in any interesting groupings.

An analysis of the clusters (labelled 1, 2 and 3 in table 9.3) shows that there is a mix of public transit users and non-users in each of the clusters (numbers under 100 represent transit users, and over 100 are auto users). Thus we can see that a clustering on utility levels does not lead to a natural division between users and non-users in the utilities they attached to the various characteristics, so the results of this cluster analysis are not particularly surprising.

Interpretation of the clusters provided one clearly definable group, and two that are less clear. Cluster number 2 in table 9.3 is composed of people who had a comparatively high utility value for the "proximity"

variable. The prospect of a three block walk at either end of the trip was not very appealing for these people. Appendix 4 contains the individual conjoint outputs for the members of this cluster. The other two clusters are not as clear. Cluster 1 appears to be a group of individuals who place no emphasis on either being on time, or waiting time. Cluster three contains a number of people for whom the on-time variable is large, but this is by no means consistent across the groups.

A second cluster approach, Fastclus, was used to cluster individuals by their utility values. This method starts by choosing an observation to be the center of each cluster, and then assigns all respondents to the nearest cluster. "Closeness" to a cluster is defined as Euclidean distances between the individuals, calculated using their utilities for each characteristic. An example of a two-cluster output based on "scores" is included in Table 9.4.

The two clusters in Table 9.4 appear to differ the most on the value they assign to the variable "price" (-35.7 for cluster 1, -18 for cluster 2). They also differ, although to a lesser extent on the "proximity" and "crowded" variables. A review of the membership in each cluster shows that, consistent with the hierarchical clustering process, the membership in each cluster is split almost evenly between transit users and non-transit users.

These two clustering approaches are presented as illustration of the types of further analyses which can be done on conjoint data. They illustrate a fact consistent with the rest of our results, namely that a simple split of the analysis into transit users and non-users may miss some important implications. People vary according to the importance

TABLE 9.4

CLUSTER SUMMARY

CLUSTER	MEMBERS	MAX DISTANCE FROM CENTER
1	83	62.58028
2	37	50.00673

CLUSTER CENTERS

CLUSTER	PRICE	PROX	FASTER
1	-35.69074074	11.00925926	2.82314815
2	-1.83750000	24.45416667	4.22916667

CLUSTER	ONTIME	WAIT	CROWDED
1	2.18240741	6.29629630	5.18703704
2	7.8041667	11.14583333	21.21250000

DISTANCES BETWEEN CLUSTER CENTERS

CLUSTER	1	2
1	.	40.505826516
2	40.505826516	.

CLUSTER=1

VARIABLE	UNCORRECTED SS	CORRECTED SS	N
DISTANCE	58549.3386	10134.8904	83
----------CLUSTER=2----------			
DISTANCE	36338.7850	2335.3802	37

they attach to particular characteristics, and it is the variation in how they perceive these characteristics to be supplied by a transit mode that determines their preferences.

10.0 MODELLING OF TRANSPORTATION MODE CHOICE

A major advantage of the type of data collected is that they can be used to develop models of consumer choice. In this mode, the analysis sample acts as a market simulation. Each respondent's utilities for attributes of travel (Table 9.2), and perceptions of the degree to which these attributes are held by varied travel modes (Table 7.2) are combined. This combined score is a measure of the value which the individual places on the mode of travel.

For example an individual respondent is found to have a utility of ten for speed of service and twenty for uncrowdedness. If he perceives car travel as "likely" (a score of 2 on the scale used in the questionnaire) to have both attributes, his car score would be (10 x 2 + 20 x 2) sixty. If he perceives TTC travel as "maybe" having speedy service (scale score 3) and "not likely" to be uncrowded (scale score 4) his TTC score would be (10 x 3 + 20 x 4) one hundred and ten. In this example a low score indicates the mode perceived as better: for this hypothetical respondent the car is preferred.

The effects of marketing variables can be predicted with the model. For example, a promotion program might succeed in changing the hypothetical respondent's preception of crowdedness. Car travel might be seen as congested or crowded with a scale score change to three and an overall score change to eighty. TTC travel might be seen as likely to be uncrowded (scale score 2) for an overall score of seventy. The mode now perceived as better is the TTC. Market tests of this variety can be conducted for a wide range of options including service adjustments, new types of service (such as dial a bus), changes in the economy (such as

increased gas costs), and combinations such as service and promotion.

Given the limited data base of this pilot study, extensive model development and market option simulations are not presented but two brief examples are described below to indicate the potential. These examples concern non-price factors, the first being a service improvement and the second a promotional campaign.

Each individual's utility scores were multiplied by that person's non-price perceptions of TTC and car to derive the individual's overall mode evaluation. The results are shown in Table 10.1 where "1" represents car commuters, "2" TTC commuters, and "3" TTC and car commuters. It can be seen that these overall evaluation scores (utility times perception) do separate the modes of commuting, albeit not perfectly. The mean scores at the bottom of the paper show that the difference between overall evaluations of TTC and car for car users was 2.25, for TTC users was -.90, and for TTC and car users was -4.41. In this example numbers that are more negative are more favourable to TTC so the mean results are consistent with choice of mode. This provides a useful validation of he conjoint analysis process: on average actual mode choices are well predicted.

The pattern of individual responses can also be examined for the degree to which overall evaluations separate mode users. The overall mean score was .10. If respondents scoring above this are assigned to car and respondents scoring below this to TTC (or TTC and car) it is found that 66 percent of respondents are correctly classified (Table 10.2). Notice this level of correct classification is attained <u>without</u> using car availability data, and is a considerable improvement on the 50% correct chance rate.

TABLE 10.1 Utility and Perceptions Scores by Mode of Travel

PRINT OF DIFFERENCES IN OVERALL PREDICTED EVALUATIONS

ID	TTC-AUTO	MODE	SUMTTC	SUMAUTO	TTC5
10	.	2	-8.00	.	5
15	.	2	-37.50	.	5
17	.	2	.	.	4
21	.	2	-10.50	.	3
22	.	2	.	-5.00	1
35	.	3	.	.	5
49	.	3	.	.	5
53	.	2	7.00	.	5
44	-38.00	2	-45.00	-7.00	5
137	-33.50	1	-42.00	-8.50	5
104	-31.00	1	-55.75	-24.75	5
25	-27.75	3	-36.00	-8.25	5
123	-27.50	1	-60.00	-32.50	5
158	-20.00	3	-25.00	-5.00	5
66	-18.50	2	11.00	29.50	1
33	-17.25	2	-26.75	-9.50	5
7	-17.00	3	-17.00	0.00	5
54	-16.00	3	-38.25	-22.25	5
61	-15.00	3	-27.00	-12.00	5
154	-14.50	1	-29.00	-14.50	5
65	-13.25	3	8.25	21.50	1
24	-13.00	3	-14.50	-1.50	5
40	-12.50	2	-25.50	-13.00	5
157	-11.00	1	-25.50	-14.50	5
38	-10.75	2	2.75	13.50	1
36	-9.25	2	-11.00	-1.75	5
135	-9.25	1	-13.50	-4.25	5
39	-9.00	3	-17.00	-8.00	5
145	-8.50	1	-17.50	-9.00	3
105	-8.25	1	-15.25	-7.00	5
113	-7.50	1	-10.75	-3.25	4
119	-7.50	1	-7.75	-0.25	1
64	-7.50	2	-11.75	-4.50	5
28	-7.00	2	-3.50	3.50	4
152	-7.00	1	-16.75	-9.75	4
5	-6.75	2	-8.75	-2.00	5
12	-6.50	3	-2.50	4.00	4
138	-6.50	1	-10.50	-4.00	3
131	-6.25	3	14.25	20.50	3
103	-5.75	1	-5.50	0.25	4
52	-5.25	3	-27.25	-22.00	5

1 = car
2 = TTC
3 = TTC and car

TABLE 10.1 (cont'd)

PRINT OF DIFFERENCES IN OVERALL PREDICTED EVALUATIONS

ID	TTC-AUTO	MODE	SUMTTC	SUMAUTO	TTC5
9	-4.75	3	-9.25	-4.50	1
112	-4.75	1	1.25	6.00	2
19	-4.00	3	-17.00	-13.00	2
20	-4.00	2	12.00	16.00	5
147	-3.50	1	-26.25	-22.75	2
23	-3.00	3	-4.00	-1.00	5
26	-3.00	2	1.50	4.50	2
32	-2.50	3	-13.25	-10.75	2
42	-2.50	2	5.00	7.50	5
159	-2.50	1	2.00	4.50	2
107	-2.00	1	-8.75	-6.75	3
160	-2.00	1	1.50	3.50	1
2	-1.50	2	-5.50	-4.00	1
34	-1.25	2	22.75	24.00	3
114	-1.00	1	-4.00	-3.00	1
6	-0.25	2	3.25	3.50	2
27	0.00	2	6.00	6.00	1
47	0.00	3	2.00	2.00	1
161	0.00	1	4.00	4.00	2
13	0.25	2	-22.25	-22.50	2
124	0.50	1	2.00	1.50	5
140	0.75	1	-8.75	-9.50	3
63	1.00	2	3.75	2.75	3
18	1.25	2	20.75	19.50	1
139	1.50	1	28.25	26.75	2
48	2.00	2	-7.00	-9.00	4
143	2.00	1	17.00	15.00	3
108	2.75	1	-8.75	-11.50	5
146	3.00	1	15.00	12.00	1
150	3.00	1	-6.00	-9.00	1
133	3.50	1	-5.25	-8.75	1
46	3.75	3	-4.25	-8.00	1
125	3.75	1	20.25	16.50	1
1	4.00	3	15.00	11.00	1
29	4.25	3	-4.75	-9.00	1
4	4.50	2	13.50	9.00	4
116	4.50	1	1.50	-3.00	2
8	4.75	2	-3.25	-8.00	3
51	5.00	3	0.50	-4.50	1
130	5.00	1	18.25	13.25	5

1 = car
2 = TTC
3 = TTC and car

TABLE 10.1 (cont'd)

PRINT OF DIFFERENCES IN OVERALL PREDICTED EVALUATIONS

ID	TTC-AUTO	MODE	SUMTTC	SUMAUTO	TTC5
148	5.00	1	-1.50	-6.50	1
11	5.25	2	31.25	26.00	2
50	5.50	2	8.00	2.50	3
120	5.50	1	2.25	-3.25	1
136	5.75	1	11.50	5.75	1
102	6.00	1	-4.50	-10.50	2
142	6.00	1	-2.50	-8.50	1
110	6.25	1	5.50	-0.75	1
101	6.50	1	28.75	22.25	4
3	6.75	2	-7.25	-14.00	1
62	7.00	2	13.00	6.00	2
117	7.00	1	-1.00	-8.00	1
141	7.00	1	2.25	-4.75	1
144	7.00	1	1.75	-5.25	2
156	7.00	1	30.50	23.50	3
43	7.50	2	6.50	-1.00	1
37	7.75	2	-6.00	-13.75	3
121	7.75	1	12.75	5.00	1
126	7.75	1	17.25	9.50	1
128	7.75	1	12.25	4.50	5
115	8.75	1	-4.50	-13.25	1
151	8.75	1	-4.75	-13.50	1
153	10.25	1	22.75	12.50	1
129	10.50	1	17.50	7.00	5
106	10.75	1	5.25	-5.50	1
134	10.75	1	5.75	-5.00	2
45	11.00	2	12.75	1.75	1
122	11.00	1	0.25	-10.75	1
155	11.75	1	19.00	7.25	1
132	12.25	1	31.75	19.50	2
109	13.00	1	3.00	-10.00	1
30	13.25	3	1.75	-11.50	1
111	14.75	1	26.00	11.25	1
60	19.00	2	-28.00	-47.00	3
16	21.00	1	42.50	21.50	1
14	25.50	3	43.25	17.75	1
118	25.50	1	19.00	-6.50	1
149	34.25	1	41.00	6.75	1
31	42.50	2	30.75	-11.75	1

1 = car
2 = TTC
3 = TTC and car

TABLE 10.1 (cont'd)

MEANS BY MODE OF OVERALL EVALUATION PREDICTIONS

MODE=1

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TTC-AUTO	59	2.245	11.573	-33.500	34.250
SUMTTC	59	1.242	20.204	-60.000	42.500
SUMAUTO	59	-1.000	12.079	-32.500	26.750
---------- MODE=2 ----------					
TTC-AUTO	32	-0.898	13.234	-38.000	42.500
SUMTTC	36	-2.306	17.900	-45.000	31.250
SUMAUTO	33	-0.311	14.909	-47.000	29.500
---------- MODE=3 ----------					
TTC-AUTO	21	-4.405	11.821	-27.750	25.500
SUMTTC	21	-6.905	18.575	-38.250	43.250
SUMAUTO	21	-2.500	12.143	-22.250	21.500

1 = car
2 = TTC
3 = TTC and car

TABLE 10.2 Prediction of Respondents Mode of Travel

Predicted	Mode of Travel	
	car	TTC or TTC and car
car	39	21
TTC or TTC and car	20	40

The service improvement simulation was developed to represent a particular problem at the research site. The office complex is situated in an extensive block of land such that its doors are located at least two blocks from the nearest bus stop. This fact was a matter of verbal complaint by a number of respondents. The TTC could easily eliminate this particular problem by looping buses through the compound. What would be the long term impact on ridership? Long term is modelled because in the short run people may be committed to the travel arrangements they have made (such as car purchase).

This hypothetical service improvement was modelled by changing respondents perceptions of proximity of TTC by two and a half scale points, the mean difference between TTC and car perceptions. The overall evaluation scores (utility times perceptions) were recalculated with the results shown in Table 10.3. The net result was to divert 16 or 27 percent of the car users to TTC. This estimate might need adjusting before being used in policy decisions (e.g. by examining respondents home distance from TTC and their price perceptions) but is nevertheless indicative of the potential value of this approach.

The hypothetical promotion concerned an assumed effective campaign to improve the perception on TTC reliability of service to equal car (two scale points). The results are shown in Table 10.4. No car users shift to transit so the promotion would be a waste of money.

The simple demonstration here shows how use of utility and perceptions data can predict programme effects. In this example, a potentially successful service improvement contrasts with a potentially ineffectual promotional campaign. With full scale data more sophisticated modelling could be applied to a wide range of scenarios. Because the simulations are at the individual level, the results could also be examined for particular market segments, for example men versus women.

TABLE 10.3 Service Improvement Simulation: Adjusted Utility x Perception Values for Car Commuters

DIFFERENCES IN OVERALL PREDICTED BETTER PROX MK3

ID	TTC1AUTO	MODE	SUM1TTC	SUMAUTO	TTC5	TTC51
137	-33.500	1	-42.000	-8.50	5	5.0
104	-31.000	1	-55.750	-24.75	5	5.0
123	-27.500	1	-60.000	-32.50	5	5.0
145	-23.500	1	-32.500	-9.00	3	5.0
119	-16.250	1	-16.500	-0.25	1	3.5
116	-15.500	1	-18.500	-3.00	2	4.5
140	-15.250	1	-24.750	-9.50	3	5.0
154	-14.500	1	-29.000	-14.50	5	5.0
138	-14.500	1	-18.500	-4.50	3	5.0
102	-14.000	1	-24.500	-10.50	2	4.5
115	-11.250	1	-24.500	-13.25	1	3.5
157	-11.000	1	-25.500	-14.50	5	5.0
113	-11.000	1	-14.250	-3.25	4	5.0
152	-10.250	1	-20.000	-9.75	4	5.0
107	-10.000	1	-16.750	-6.75	3	5.0
103	-9.500	1	-9.250	0.25	4	5.0
135	-9.250	1	-13.500	-4.25	5	5.0
114	-8.500	1	-11.500	-3.00	1	3.5
105	-8.250	1	-15.250	-7.00	5	5.0
159	-7.500	1	-3.000	4.50	2	4.5
150	-7.000	1	-16.000	-9.00	1	3.5
109	-7.000	1	-17.000	-10.00	1	3.5
110	-6.250	1	-7.000	-0.75	1	3.5
160	-5.750	1	-2.250	3.50	1	3.5
112	-5.375	1	0.625	6.00	2	4.5
148	-5.000	1	-11.500	-6.50	1	3.5
142	-4.000	1	-12.500	-8.50	1	3.5
125	-3.125	1	13.375	16.50	1	3.5
117	-3.000	1	-11.000	-8.00	1	3.5
133	-2.125	1	-10.875	-8.75	1	3.5
120	-2.000	1	-5.250	-3.25	1	3.5
147	-1.625	1	-24.375	-22.75	2	4.5
139	-1.625	1	25.125	26.75	2	4.5
121	-1.625	1	3.375	5.00	1	3.5
161	-1.250	1	2.750	4.00	2	4.5
141	-0.500	1	-5.250	-4.75	1	3.5
124	0.500	1	2.000	1.50	5	5.0
144	0.750	1	-4.500	-5.25	2	4.5
108	2.750	1	-8.750	-11.50	5	5.0
146	3.000	1	15.000	12.00	1	3.5
101	3.750	1	26.000	22.25	4	5.0
132	4.125	1	23.625	19.50	2	4.5
136	4.500	1	10.250	5.75	1	3.5
130	5.000	1	18.250	13.25	5	5.0

TABLE 10.3 (cont'd)

DIFFERENCES IN OVERALL PREDICTED BETTER PROX MK3

ID	TTC1AUTO	MODE	SUM1TTC	SUMAUTO	TTC5	TTC51
106	5.125	1	-0.375	-5.50	1	3.5
118	5.500	1	-1.000	-6.50	1	3.5
134	6.375	1	1.375	-5.00	2	4.5
126	6.500	1	16.000	9.50	1	3.5
156	7.000	1	30.500	23.50	3	5.0
128	7.750	1	12.250	4.50	5	5.0
151	8.125	1	-5.375	-13.50	1	3.5
155	8.625	1	15.875	7.25	1	3.5
153	9.000	1	21.500	12.50	1	3.5
122	9.750	1	-1.000	-10.75	1	3.5
143	10.000	1	25.000	15.00	3	5.0
129	10.500	1	17.500	7.00	5	5.0
111	14.750	1	26.000	11.25	1	3.5
16	18.500	1	40.000	21.50	1	3.5
149	26.125	1	32.875	6.75	1	3.5

TABLE 10.4 Promotion Simulation: Adjusted Utility x Perception Values for Car Commuters

DIFFERENCES IN OVERALL PREDICTED ONTIME IMPROVED BY 2 MK3

ID	TTC2AUTO	MODE	SUM2TTC	SUMAUTO	TTC6	TTC61
137	-33.50	1	-42.00	-8.50	1	1
104	-29.50	1	-54.25	-24.75	5	3
123	-27.00	1	-59.50	-32.50	5	3
154	-18.50	1	-33.00	-14.50	5	3
119	-12.50	1	-12.75	-0.25	5	3
157	-11.00	1	-25.50	-14.50	2	1
145	-8.00	1	-17.00	-9.00	3	1
105	-7.75	1	-14.75	-7.00	3	1
113	-7.25	1	-10.50	-3.25	2	1
152	-7.00	1	-16.75	-9.75	4	2
138	-6.50	1	-10.50	-4.00	4	2
135	-6.25	1	-10.50	-4.25	5	3
103	-5.75	1	-5.50	0.25	5	3
112	-4.75	1	1.25	6.00	2	1
107	-3.50	1	-10.25	-6.75	3	1
124	-3.50	1	-2.00	1.50	3	1
159	-2.50	1	2.00	4.50	1	1
114	-1.00	1	-4.00	-3.00	4	2
102	-1.00	1	-11.50	-10.50	3	1
161	0.00	1	4.00	4.00	5	3
140	0.25	1	-9.25	-9.50	4	2
133	1.00	1	-7.75	-8.75	4	2
116	1.50	1	-1.50	-3.00	3	1
160	2.00	1	5.50	3.50	3	1
143	2.00	1	17.00	15.00	1	1
150	2.00	1	-7.00	-9.00	3	1
108	2.50	1	-9.00	-11.50	2	1
129	2.50	1	9.50	7.00	5	3
139	3.00	1	29.75	26.75	4	2
146	3.00	1	15.00	12.00	3	1
147	3.50	1	-19.25	-22.75	2	1
148	3.50	1	-3.00	-6.50	3	1
121	3.75	1	8.75	5.00	3	1
136	4.25	1	10.00	5.75	3	1
128	4.25	1	8.75	4.50	3	1
141	4.50	1	-0.25	-4.75	3	1
110	4.75	1	4.00	-0.75	3	1
142	5.00	1	-3.50	-8.50	3	1
156	5.00	1	28.50	23.50	5	3
144	5.50	1	0.25	-5.25	5	3
126	25.75	1	15.25	9.50	5	3
120	6.00	1	2.75	-3.25	1	1
101	6.50	1	28.75	22.25	5	3
134	6.75	1	1.75	-5.00	5	3
117	7.00	1	-1.00	-8.00		

TABLE 10.4 (Cont'd)

DIFFERENCES IN OVERALL PREDICTED ONTIME IMPROVED BY 2 MK3

ID	TTC2AUTO	MODE	SUM2TTC	SUMAUTO	TTC6	TTC61
125	7.25	1	23.75	16.50	3	1
115	8.25	1	-5.00	-13.25	5	3
106	8.25	1	2.75	-5.50	5	3
122	8.50	1	-2.25	-10.75	4	2
151	8.75	1	-4.75	-13.50	1	1
132	9.75	1	29.25	19.50	5	3
130	10.00	1	23.25	13.25	5	3
153	10.25	1	22.75	12.50	3	1
155	11.75	1	19.00	7.25	2	1
109	13.00	1	3.00	-10.00	2	1
111	15.25	1	26.50	11.25	3	1
16	18.00	1	39.50	21.50	4	2
118	21.00	1	14.50	-6.50	5	3
149	29.25	1	36.00	6.75	3	1

11.0 CONCLUSIONS

The purpose of this research was to foster energy conservation through encouragement of transit use, particularly by commuters who do not currently use transit. The objective of the study was to test a methodology that would measure the values of and perceptions toward travel to work. The methodology could then be used to help plan for increased transit use.

A self-completion questionnaire was developed and pilot tested with a convenience sample of 120 commuters. The research instrument proved to be understandable, sensitive enough to discriminate between transit and non-transit users, and answerable by respondents. A few improvements in instructions would be made for further administrations of the questionnaire, and more rotation of questionnaire items would be used in a larger scale administration. The factor analysis of attitude scales indicate two further dimensions, "safety" and "good for bad weather" that might be added to the original six value and perception measures. Other than these minor adjustments, the research instrument is ready for full scale application.

The data from the pilot test should not be used for policy decisions owing to the limited sample. But the results, included in the report in section 6 to 10 show the kind of information that can be provide by the research instrument. The perceptions data in Table 7.2 indicate substantial differences in the way transit and non-transit users view aspects of their journey to work. Although cost is the single most significant factor to respondents (Table 9.2), it is also clear that commuters' perceptions of proximity, waiting time, crowdedness, punctuality, and speed

are all important in the ride decision.

Price was the most dominant ride characteristic (Table 9.2). The perceptions data (Table 7.2) indicates that transit and non-transit users do not see a sharp difference in the cost of car and transit. Thus car users were likely including only gasoline costs in their total cost estimates. To remain competitive, transit must promote the full costs of car travel, and maintain its own perceived cost advantage. Given that all the perceptual items in Table 7.2 favour car except cost, some cost saving must always be present as a balancing factor.

The attitudinal data provided two additional areas for transit promotion. Transit was regarded as safer than car travel and this could be emphasized in promotions. The comparative safey of transit in bad weather is not perceived by car owners, and an educational programme could be in order.

The consumer modelling reported in section 10 is potentially the most valuable output from this type fo research. There it was seen that a simulated service improvement (looping a bus route into an office complex) could significantly increase ridership. A simulated promotional campaign (on service reliability) had no effect on ridership. The service improvement would be economical to bring into operation and would likely be successful. The promotion would be expensive and likely to be unsuccessful. The modelling reported in the pilot is only an indication of the many management options that could be evaluated this way.

11.1 Recommendation

Since the methodology is proven, and the potential for operational results demonstrated, the research should move from pilot to full scale

implementation. Values and perceptions are likely to vary both by cities and by segments of commuters within cities, so a substantial (2,000 replies), randomly drawn, sample should be used in each city of interest. Since the questionnaire proved answerable in self-completion mode, administration could, for economy, be by mail. The field research should be complemented by alternative service improvement and promotional scenarios that would be evaluated by using the collected data for consumer modelling.

APPENDIX 1: QUESTIONNAIRE AND COVERING LETTER

CENTRE FOR APPLICATIONS OF
MANAGEMENT SCIENCE IN MARKETING

Faculty of Administrative Studies
York University
4700 Keele Street
Downsview, Ontario, M3J 1P6

TRAVEL TO WORK SURVEY

Good morning.

We are doing a study of what people think about different ways of travelling to work. Our objective is to suggest changes which might be made to the transportation system to improve your work trip every morning.

We would appreciate your taking fifteen minutes at your coffee break, lunch or this evening before you leave, to complete this questionnaire. As a token of our appreciation, we will give you a free WINTARIO ticket when you hand in the completed questionnaire.

Our people will be in the lobby throughout the day to answer questions and as you leave work to accept your questionnaire, and give you your Wintario ticket.

Remember the questionnaire is completely anonymous. The Ministry of Transportation and Communications has kindly allowed us to distribute questionnaires to you but is not involved in this study.

Thank you.

Have a nice day!

1. How many times in the last 5 working days have you taken the following transit modes to work?

a) car ____
b) TTC ____
c) car & TTC ____

On which type of transit do you spend the most time?

subway ____
bus ____
streetcar ____

d) Some method other than car or TTC? _____

What was this "other" method? _____

_____

2. How would you classify your travel-to-work behaviour (Please check one response only)

____ I am a regular user of public transportation because I have no alternative.

____ I am a regular user of public transportation by choice.

____ I occasionally use public transportation by choice.

____ I occasionally use public transportation, but only when I have to.

____ I don't use public transportation at the present time, although I have used it in the past.

____ I don't use public transportation and I never have in the past.

3. What is the nearest major intersection to your home? (e.g. King and Bay, Hwy. 7 and Keele).

_____

PART 2:

We would like you to evaluate first public transit, then the private automobile as methods for getting to work. For each of the following statements, show how much you agree or disagree.

For example:

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
Air conditioning is essential on a hot day	_____	____	_____	_____	_____

If you agree with the statement above, put a check (x) on the space under "agree" as in the example. If, on the other hand, you do not agree with this statement, you would put a check (x) under "disagree" or "strongly disagree".

Thinking now about PUBLIC TRANSIT as a method of getting to work

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
1. I can get to work on time using the TTC.	____	____	____	____	____
2. I arrive at work relaxed when I use the TTC.	____	____	____	____	____
3. It's never too hot or cold on the TTC	____	____	____	____	____
4. I never worry about my safety on the TTC	____	____	____	____	____
5. There is little effort involved in travelling by TTC	____	____	____	____	____
6. The TTC is there when I want it	____	____	____	____	____
7. I am not made uncomfortable by others when travelling by TTC	____	____	____	____	____
8. I save money travelling by TTC	____	____	____	____	____
9. There are no problems with bad weather on the TTC	____	____	____	____	____
10. TTC gets me to work quickly.	____	____	____	____	____
11. There are no long waits for the TTC	____	____	____	____	____
12. It is tiring travelling by TTC	____	____	____	____	____
13. I'm not annoyed by loud talking or other people when travelling by TTC	____	____	____	____	____
14. It is easy to walk to TTC	____	____	____	____	____

Thinking now about PUBLIC TRANSIT as a method of getting to work

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
15. Overcrowding is not a problem with the TTC	____	____	____	____	____
16. I don't worry about traffic accidents with the TTC	____	____	____	____	____
17. I can control my own environment with the TTC	____	____	____	____	____
18. I would always choose TTC on a snowy day	____	____	____	____	____
19. It is inexpensive to travel to work by TTC	____	____	____	____	____
20. It takes too long to travel to work by TTC	____	____	____	____	____

Now thinking of the AUTOMOBILE as a method of getting to work

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
1. I can get to work on time using a car	____	____	____	____	____
2. I arrive at work relaxed when I use a car	____	____	____	____	____
3. It's never too hot or cold in a car	____	____	____	____	____
4. I never worry about my safety in a car	____	____	____	____	____
5. There is little effort involved in travelling by car	____	____	____	____	____
6. The car is there when I want it	____	____	____	____	____
7. I am not made uncomfortable by others when travelling by car	____	____	____	____	____
8. I save money travelling by car	____	____	____	____	____
9. There are no problems with bad weather in a car	____	____	____	____	____
10. The car gets me to work quickly	____	____	____	____	____
11. There are no long waits in a car	____	____	____	____	____
12. It is tiring travelling by car	____	____	____	____	____
13. I'm not annoyed by loud talking or other people when travelling by car	____	____	____	____	____
14. It is easy to walk to the car	____	____	____	____	____

Now thinking of the AUTOMOBILE as a method of getting to work

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
15. Overcrowding is not a problem with a car	____	____	____	____	____
16. I don't worry about traffic accidents in the car	____	____	____	____	____
17. I can control my own environment with a car	____	____	____	____	____
18. I would always choose a car on a snowy day	____	____	____	____	____
19. It is inexpensive to travel to work by car	____	____	____	____	____
20. It takes too long to travel to work by car	____	____	____	____	____

PART 3:

Now we would like you to look at a series of descriptions of a "trip to work". The trips described on the set of cards* are not meant to be either public transit or automobile, but rather a trip which might be taken by either mode.

Each card in the set contains six statements describing characteristics of a trip to work. What we would like you to do is sort these cards into a pile where the card on the top of the pile most closely describes your preferred trip to work, and all the other cards are in descending order of preference for the trip to work.

Many people find that it is easier to sort the cards if they first divide them into two piles - one describing "good" trips, and the other describing "bad" trips. Then each of these two piles can be divided as well - perhaps into "best", "medium" and "average" for the "good" pile, and "average" and "awful" for the "bad" pile. If you continue to divide the piles, you will soon have all the cards sorted in order. Although this task may seem complicated, there are only 16 cards to sort, so most people find it really only takes a few minutes. We appreciate your efforts.

Now - we would like you to do 2 things with the sorted cards:

1. Number them in order of preference in the box in the top right hand corner - 1 for the most preferred, 2 for the next most preferred, etc., to 16 for the least preferred.

2. Starting with the "trip" which you rated as number 1, asign it 100 points. Assume that all the other trips can have between 0 and 100 points, depending on how good or bad they are, write the number of points on the line below the box where you put the rank on the cards. The only restriction is that the trip ranked "2" must be given fewer points than the trip ranked "1", and similarly for all lower ranks - the points assigned must be lower for lower ranked trips.

* see Appendix 2.

How likely is a trip to work on the TTC:	very likely				not at all likely
to cost $10 per week	___	___	___	___	___
to have plenty of space for you to sit	___	___	___	___	___
to be 15 minutes faster than your current trip	___	___	___	___	___
to require a 10 minute walk	___	___	___	___	___
to need a 3 block walk at one end	___	___	___	___	___
to always get you to work right on schedule	___	___	___	___	___

How likely is a trip to work by car:	very likely				not at all likely
to cost $10 per week	___	___	___	___	___
to cost $25 per week	___	___	___	___	___
to have plenty of space for you to sit	___	___	___	___	___
to be 15 minutes faster than your current trip	___	___	___	___	___
to require a 10 minute walk	___	___	___	___	___
to need a 3 block walk at one end	___	___	___	___	___
to always get you to work right on schedule	___	___	___	___	___

PART 4:

Now we would like to get some information about you.

1. Are you: Male? ____ Female? ____
2. Which age range do you fall in?
   - ____ less than 25
   - ____ 25 - 44
   - ____ 45 - 65
   - ____ over 65
3. What is your occupation? _____
4. What is the highest level of education you have?
   - ____ less than high school graduation
   - ____ high school graduate
   - ____ some college or university
   - ____ college or university graduate
   - ____ post graduate study
5. In which range does your family's total income fall?
   - ____ less than $15,000
   - ____ $15,000 to 25,000
   - ____ $25,000 to $40,000
   - ____ over $40,000
6. Does anybody in your family have a car?
   ____ yes ____ no
7. Do you personally have a car available to you to take to work?
   ____ yes ____ no
8. How far is the nearest TTC stop from your home?
   _____
9. If you ever drive to work instead of taking the available public transit system, what types of reasons might you have?
   _____
   _____

APPENDIX 2 Scenarios Used in Section 3 of Questionnaire

Notes: 1. The figure on the left hand bottom edge of each scenario indicates the average number of points allocated to that scenario by respondents.

2. The figure in the right hand bottom edge of each scenario shows the preference rank order for each scenario (based on the number of points allocated).

Cost: $25/week
Door to door service
2 minute wait
15 minutes faster than your current trip
Plenty of space for you to sit
You always arrive right on schedule

60 6

Cost: $25/week
Door to door service
2 minute wait
Will take as long as your current trip
May be too crowded for comfort
You have to allow leeway for delays

42 11

Cost: $25/week
Door to door service
10 minute wait
15 minutes faster than your current trip
May be too crowded for comfort
You have to allow leeway for delays

38 13

Cost: $25/week
Door to door service
10 minute wait
Will take as long as your current trip
Plenty of space for you to sit
You always arrive right on schedule

49 10

Cost: $25/week
3 block walk at one end
2 minute wait
15 minutes faster than your current trip
May be too crowded for comfort
You have to allow leeway for delays

32 15

Cost: $25/week
3 block walk at one end
2 minute wait
Will take as long as your current trip
Plenty of space for you to sit
You always arrive right on schedule

42 11

Cost: $25/week
3 block walk at one end
10 minute wait
15 minutes faster than your current trip
Plenty of space for you to sit
You always arrive right on schedule

38 13

Cost: $25/week
3 block walk at one end
10 minute wait
Will take as long as your current trip
May be too crowded for comfort
You have to allow leeway for delays

24 16

Cost: $10/week
Door to door service
2 minute wait
15 minutes faster than your current trip
May be too crowded for comfort
You always arrive right on schedule

79 2 (for car 1)

Cost: $10/week
Door to door service
2 minute wait
Will take as long as your current trip
Plenty of space for you to sit
You have to allow leeway for delays

82 (88 car, 76 transit) 1(for transit 2)

Cost: $10/week
Door to door service
10 minute wait
15 minutes faster than your current trip
Plenty of space for you to sit
You have to allow leeway for delays

75 3

Cost: $10/week
Door to door service
10 minute wait
Will take as long as your current trip
May be too crowded for comfort
You always arrive right on schedule

66

Cost: $10/week
3 block walk at one end
2 minute wait
15 minutes faster than your current trip
Plenty of space for you to sit
You have to allow leeway for delays

67

Cost: $10/week
3 block walk at one end
2 minute wait
Will take as long as your current trip
May be too crowded for comfort
You always arrive right on schedule

58 7

Cost: $10/week
3 block walk at one end
10 minute wait
15 minutes faster than your current trip
May be too crowded for comfort
You always arrive right on schedule

56 9

Cost: $10/week
3 block walk at one end
10 minute wait
Will take as long as your current trip
Plenty of space for you to sit
You have to allow leeway for delays

57 8

APPENDIX 3: Verbatim Responses to Question 4.9

"If you ever drive to work instead of taking the available public transit system, what types of reasons might you have?"

Transit Users

Respondent	Comment
001	Weather, especially heavy rains. Sleep in. Need to get home quickly for dentist or doctor appointment. Have to run errand at noon.
002	If I am making a trip out of town, I would drive to that particular destination from work rather than going home first.
003	Late for work. Going to doctors.
004	Car needed at lunch hour. Weather.
005	Driving to work takes less time most times.
006	Bad weather. If I wake up late and have to get to work quickly.
009	Pay day. Required to go somewhere after work. Pick something up after work. Late leaving home.
012	Faster. My convenience.
018	Comfort, speed, convenience, no crowds or pushy people, no cars splashing me on rainy days, don't have to wear so much extra clothing in winter, can run errands after work and still get home sooner than going straight there on the bus.
019	Mobility needed for 2 or more people. Midday or evening business in C.B.D. or/and mid-town, combining with M.T.C. courier and H.R.T.
022	Comfort. Not to be touched by someone else. Listen to what I want to listen.
025	Really no reason unless I sleep in or its very cold.
026	No.
027	Yes I can.
028	T.T.C. strike.
029	Pay day, need car to go to bank, slept in, have an appointment later in day that would be quicker to drive to than by bus. My turn to drive out for lunch. Going somewhere special after work.

Respondent #	Comment
031	Got up late, pouring rain, feeling ill but well enough to work, i.e. back pain, stomach ache.
032	Time, appointments, convenience.
033	To have more free time available.
034	Time, privacy and not having to stand at a bus stop in bad weather.
035	If I have to call at a place on way home to do some shopping.
036	More convenient.
037	Convenience, time, comfort, cartage, occasional passenger, flexibility.
038	I don't drive.
039	I'd rather come by car than bus because bus travel is too expensive, uncomfortable, unreliable, dirty and crowded. I hate the bus.
040	Pick up my husband. Go shopping and do errands. Visit friends and relatives.
043	Carrying things, golf clubs, etc. Appointments elsewhere during the day.
044	If I can get a ride I do. I would not use public transportation if I had a choice.
045	I don't drive.
047	I get a ride everyday.
048	To save time.
049	Sickness.
050	Going to be late, rain, cold outside, "TTC strike". Want to get up from bed later, planning to go to restaurant for lunch, shopping, pick someone up after work, etc.
053	Faster, more comfortable, more privacy.
060	Plenty of space, comfort and privacy. I don't have to stand in the cold waiting for connecting bus; and listening to music.

Respondent	Comment
061	If there was a T.T.C. strike.
062	Have to go somewhere from work and car faster way. Have to go somewhere after work. Need the car for shopping during lunch break.
063	It was raining. Had to go someplace after work.
065	If it is raining or I have to go somewhere else after work, or if it is too cold to walk in the winter time.

Non-Transit Users

Respondent #	Comments
016	My time is more flexible with a car. Working late hours - no waiting. Commuting time by car is ½ that by transit.
101	The T.T.C. vehicles take longer; also they are not as comfortable as a car since they are crowded during "rush hour" which is when I would use it.
102	Too crowded, weather, running late.
103	Convenience.
104	Always drive.
105	I come to work in a car (car-pool) or I drive my own car.
106	We pool a ride, 4 of us in the family. Cheaper, readily available, safer, no frustration of people, no waiting. No long waiting or riding. Around 15 minutes to work by car, 1.15 at least by T.T.C.
107	Overcrowded buses, waiting for the buses, only 10 minutes by car.
108	Require car during the day for trips outside Toronto. Delay at bus stop in evening is unacceptable (more than 10 minutes).
109	Faster, more comfortable, more convenient.
110	My trip to work is 4½ miles and takes 10 plus minutes. Public transit would take a walk to subway, 1 subway station trip, transfer to bus, 500' walk from bus stop to office, about 45 minutes. Car is faster, probably cheaper, free parking, leaves when I'm ready, convenient, comfortable. I also use my car occasionally to drive to meetings etc. during work.
111	Convenience, easy access to work. Reasonably, inexpensive mode.
112	The buses are always jammed pack full, they smell and are always too hot. Plus ½ the time the bus driver leaves you wait for the next bus which is just as full.
113	My wife and I both work at the same place.
114	Very quick, convenient, dependable.

Respondent #	Comments
115	Convenience.
116	Faster, more convenient, more comfortable.
117	Time: saves approximately 30 minutes travelling time by car.
118	Too crowded, too smelly, long walks, cold in winter, NOISY, POOR VALUE, DELAYS, TRANSFERS, TERRIBLE in snowstorms, poor service in evenings or weekends.
119	It would take close to three hours for me to get to work by T.T.C. (I have tried it once) (and only once).
121	Convenience, comfort, speed, cost (equal to T.T.C.).
122	Faster, always a seat, no crowding, no long walk to Wilson bus, no walk from TTC to building, control my own leaving time and not have to wait for a schedule - long wait for Bombay bus to Wilson and back, so I walk to Wilson.
124	I always drive to work! Even when I lived in Richmond Hill, I found public transit to be a nuisance and at times, totally unreliable, especially in the winter. The buses are always too hot, usually over-crowded, but I must say the subway was, and still is reasonably acceptable. However, whether travelling from Richmond Hill or from my present location in Downsview, I still must leave home at least ½ hour earlier if I use public transit!
125	I almost always drive to this location because: 1. Car access is easy, and no charge for parking. 2. Transit access is terrible from where I live. 3. Transit takes too long. 4. Always use transit to go downtown on business from this location, if I am returning before end of day. 5. I won't take a carpool, or express bus on Hwy. 401 if available.
126	TTC takes too long and too many transfers.
128	Convenience, save time, no crowding, no waiting, freedom of movement.
129	Long walk to TTC, no direct route, time consuming. Currently I am in a carpool with three other fellow workers, which helps to cut down my driving east and the carpool is operating successfully for over the last three years.

Respondent #	Comments
130	Faster, cheaper, relaxing, not overcrowded, can fit shopping, etc. into lunch hours etc. No pushing, shoving, radios blaring, etc.
131	To drive it takes 15 minutes, to use TTC it takes 100 minutes. I use TTC only when car not available even though the cost of using my car is double that of TTC.
132	Costs the same, always room, no overcrowding, more freedom.
133	I am used to taking my own car for convenience and it takes much less time to commute to and fro.
134	Convenient. Carpool.
135	Car required during day on occasion. TTC would take too long. It would be a long circuitous route by TTC.
136	Faster by car.
137	Time and comfort. Independence.
138	First reason is, the TTC is too crowded (rush hour) and second, one waits for ten to fifteen minutes at a transfer point for another bus and when a bus does come along, it is packed.
139	Buses too crowded, have to wait for buses, too cold to stand outside waiting for a bus because shelters are full.
140	Always drive, have a child to take to babysitter.
141	Too far with TTC, many transfers, long trip, twice to pay for tickets. Not convenient. Sharing a ride with member of family.
142	More economical, more personal, convenience.
143	Door to door service. No waiting, no transferring, does not take as long.
144	1 3/4 hours by transit each way, leaving home 6 a.m., returning 6:30 p.m. Car 25 minutes each way.
145	Convenience, speed, comfort, laziness.
146	Less travelling time. Parking is no problem.
147	I simply prefer the convenience, it takes less time, more comfortable particularly in bad weather. However, expense is becoming a real consideration.

Respondent	Comments
149	More comfortable, don't have to wait, listen to music, no standing up.
150	Takes 3 buses.
151	Distance to work would be farther by TTC. For the above reason more expensive.
152	Job oriented trips. Get home in time for kids.
153	Arrive earlier, not crowded, no walking to bus, convenient.
154	No parking problems, more comfortable, faster service.
155	Pure laziness!!!
156	I drive in to work in a carpool. I find the company of the people I drive with of my choice. I enjoy the quietness and plenty of space to sit. My driver is prompt and reliable. We must be at work on time every day and she sees that we get there promptly and is very seldom off.
157	Convenience and faster.
158	Too long waiting for the bus. Too expensive by bus. Too crowded on bus. More comfortable by car and faster, also I love driving.
159	It's more relaxing by car and it's not packed like on a bus. I feel more relaxed when I get to work, not on a bus because you end up running to a bus stop, and sometimes if you miss the bus, you end up waiting 20 minutes and by the time you get to work, you're exhausted from rushing.
160	More convenient, greater mobility, independence.
161	Convenience - share a ride, faster time, less expensive for two people. Parking no problem.

APPENDIX 4

Individual Utilities, Cluster 2

SYSREG ON AN INDIVIDUAL BASIS
ID=3

MODEL:	EQUI	SSE	37.250000	F RATIO	12.19
		DFE	9	PROB F	0.0007
DEP VAR:	RANK	MSE	4.138889	R-SQUARE	0.8904

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.375000	1.345646	6.2238	0.0002
PRICE	1	6.750000	1.017213	6.6358	0.0001
PROX	1	-5.000000	1.017213	-4.9154	0.0008
WAIT	1	-1.750000	1.017213	-1.7204	0.1195
FASTER	1	-0.500000	1.017213	-0.4915	0.6348
CROWDED	1	-0.500000	1.017213	-0.4915	0.6348
ONTIME	1	1.250000	1.017213	1.2288	0.2503

SYSREG ON AN INDIVIDUAL BASIS
ID=5

MODEL:	EQUI	SSE	37.500000	F RATIO	12.10
		DFE	9	PROB F	0.0007
DEP VAR:	RANK	MSE	4.166667	R-SQUARE	0.8897

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	7.750000	1.350154	5.7401	0.0003
PRICE	1	7.750000	1.020621	7.5934	0.0001
PROX	1	-3.000000	1.020621	-2.9394	0.0165
WAIT	1	-1.000000	1.020621	-0.9798	0.3528
FASTER	1	-1.000000	1.020621	-0.9798	0.3528
CROWDED	1	0.750000	1.020621	-0.7348	0.4811
ONTIME	1	-2.000000	1.020621	1.9596	0.0817

SYSREG ON AN INDIVIDUAL BASIS
ID=7

MODEL:	EQUI	SSE	0	F RATIO	999999.99
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0	R-SQUARE	1.0000

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	8.000000	0		
PRICE	1	8.000000	0		
PROX	1	-4.000000	0		
WAIT	1	0	0		
FASTER	1	-1.000000	0		
CROWDED	1	0	0		
ONTIME	1	-2.000000	0		

SYSREG ON AN INDIVIDUAL BASIS
ID=8

MODEL:	EQUI	SSE	4.250000	F RATIO	118.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.472222	R-SQUARE	0.9875

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	8.625000	0.454530	18.9757	0.0001
PRICE	1	8.000000	0.343592	23.2834	0.0001
PROX	1	-3.500000	0.343592	-10.1865	0.0001
WAIT	1	-1.750000	0.343592	-5.0932	0.007
FASTER	1	0	0.343592		
CROWDED	1	-1.250000	0.343592	-3.6380	0.0054
ONTIME	1	-1.175000	0.343592	-5.0932	0.0007

SYSREG ON AN INDIVIDUAL BASIS
ID=33

MODEL:	EQUI	SSE	4.250000	F RATIO	118.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.472222	R-SQUARE	0.9875

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	7.625000	0.454530	16.7765	0.0001
PRICE	1	8.000000	0.343592	23.2834	0.0001
PROX	1	-4.000000	0.343592	-11.6417	0.0001
WAIT	1	-1.500000	0.343592	-4.3656	0.0018
FASTER	1	-0.750000	0.343592	-2.1828	0.0569
CROWDED	1	0.750000	0.343592	2.1828	0.0569
ONTIME	1	-0.750000	0.343592	-2.1828	0.0569

SYSREG ON AN INDIVIDUAL BASIS
ID=37

MODEL:	EQUI	SSE	6.500000	F RATIO	76.96
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.722222	R-SQUARE	0.9809

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	1.562114	14.2320	0.0001
PRICE	1	8.000000	0.424918	18.8271	0.0001
PROX	1	-4.000000	0.424918	-9.4136	0.0001
WAIT	1	-1.250000	0.424918	-2.9417	0.0164
FASTER	1	-1.250000	0.424918	-2.9417	0.0164
CROWDED	1	-0.500000	0.424918	-1.1767	0.2695
ONTIME	1	0	0.424918		

SYSREG ON AN INDIVIDUAL BASIS
ID=39

MODEL: EQUI
DEP VAR: RANK

		SSE	0	F RATIO	999999.99
		DFE	9	PROB F	0.0001
		MSE	0	R-SQUARE	1.0000

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	8.000000	0		
PRICE	1	8.000000	0		
PROX	1	-4.000000	0		
WAIT	1	-2.000000	0		
FASTER	1	-1.000000			
CROWDED	1	0			
ONTIME	1	0			

SYSREG ON AN INDIVIDUAL BASIS
ID=40

MODEL: EQUI
DEP VAR: RANK

		SSE	3.000000	F RATIO	168.50
		DFE	9	PROB F	0.0001
		MSE	0.333333	R-SQUARE	0.9912

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	7.250000	0.381881	18.9850	0.0001
PRICE	1	8.000000	0.288675	27.7128	0.0001
PROX	1	-4.000000	0.288675	-13.8564	0.0001
WAIT	1	-1.500000	0.288675	-5.1962	0.0006
FASTER	1	0	0.288675		
CROWDED	1	-1.000000	0.288675	-3.4641	0.0071
ONTIME	1	1.000000	0.288675	3.4641	0.0071

SYSREG ON AN INDIVIDUAL BASIS
ID=46

MODEL:	EQUI	SSE	4.250000	F RATIO	118.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.472222	R-SQUARE	0.9875

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	7.875000	0.454530	17.3256	0.0001
PRICE	1	8.000000	0.343592	23.2834	0.0001
PROX	1	-4.000000	0.343592	-11.6417	0.0001
WAIT	1	-1.500000	0.343592	-4.3656	0.0018
FASTER	1	-0.250000	0.343592	-0.7276	0.4854
CROWDED	1	-0.250000	0.343592	-0.7276	0.4854
ONTIME	1	-1.250000	0.343592	-3.6380	0.0054

SYSREG ON AN INDIVIDUAL BASIS
ID=48

MODEL:	EQUI	SSE	2.000000	F RATIO	253.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.222222	R-SQUARE	0.9941

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0.311805	25.6571	0.0001
PRICE	1	8.000000	0.235702	33.9411	0.0001
PROX	1	-4.000000	0.235702	-16.9706	0.0001
WAIT	1	-0.500000	0.235702	-2.1213	0.0629
FASTER	1	-2.000000	0.235702	-8.4853	0.0001
CROWDED	1	-0.500000	0.235702	-2.1213	0.0629
ONTIME	1	0	0.235702		

SYSREG ON AN INDIVIDUAL BASIS
ID=51

MODEL:	EQUI	SSE	1.500000	F RATIO	338.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.166667	R-SQUARE	0.9956

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0.270031	29.6262	0.0001
PRICE	1	8.000000	0.204124	3919184	0.0001
PROX	1	-4.000000	0.204124	-19.5959	0.0001
WAIT	1	-1.750000	0.204124	-8.5732	0.0001
FASTER	1	-1.250000	0.204124	-6.1237	0.0002
CROWDED	1	0	0.204124		
ONTIME	1	0	0.204124		

SYSREG ON AN INDIVIDUAL BASIS
ID=61

MODEL:	EQUI	SSE	2.000000	F RATIO	253.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.222222	R-SQUARE	0.9941

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0.311805	25.6571	0.0001
PRICE	1	8.000000	0.235702	33.9411	0.0001
PROX	1	-4.000000	0.235702	-16.9706	0.0001
WAIT	1	-2.000000	0.235702	-8.4853	0.0001
FASTER	1	-0.500000	0.235702	-2.1213	0.0629
CROWDED	1	-0.500000	0.235702	-2.1213	0.0629
ONTIME	1	0	0.235702		

SYSREG ON AN INDIVIDUAL BASIS
ID=107

MODEL:	EQUI	SSE	9.250000	F RATIO	53.64
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	1.027778	R-SQUARE	0.9728

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	7.875000	0.670562	11.7439	0.0001
PRICE	1	8.000000	0.506897	15.7823	0.0001
PROX	1	-4.000000	0.506897	-7.8912	0.0001
WAIT	1	-1.250000	0.506897	-2.4660	0.0358
FASTER	1	0	0.506897		
CROWDED	1	-0.750000	0.506897	-1.4796	0.1731
ONTIME	1	-0.750000	0.506897	-1.4796	0.1731

SYSREG ON AN INDIVIDUAL BASIS
ID=110

MODEL:	EQUI	SSE	35.250000	F RATIO	12.97
		DFE	9	PROB F	0.0006
DEP VAR:	RANK	MSE	3.916667	R-SQUARE	0.8963

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	10.875000	1.309023	8.3077	0.0001
PRICE	1	6.250000	0.989529	6.3161	0.0001
PROX	1	-5.000000	0.989529	-5.0529	0.0007
WAIT	1	-3.000000	0.989529	-3.0317	0.0142
FASTER	1	-1.250000	0.989529	-1.2632	0.2382
CROWDED	1	-1.000000	0.989529	-1.0106	0.3386
ONTIME	1	-0.750000	0.989529	-0.7579	0.4679

SYSREG ON AN INDIVIDUAL BASIS
ID=113

MODEL:	EQUI	SSE	13.250000	F RATIO	36.99
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	1.472222	R-SQUARE	0.9610

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	7.875000	0.802557	9.8124	0.0001
PRICE	1	8.000000	0.606676	13.1866	0.0001
PROX	1	-3.500000	0.606676	-5.7691	0.0003
WAIT	1	-1.500000	0.606676	-2.4725	0.0354
FASTER	1	-1.750000	0.606676	-2.8846	0.0180
CROWDED	1	-0.250000	0.606676	-0.4121	0.6899
ONTIME	1	-0.250000	0.606676	0.4121	0.6899

SYSREG ON AN INDIVIDUAL BASIS
ID=117

MODEL:	EQUI	SSE	0	F RATIO	999999.99
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0	R-SQUARE	1.0000

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0		
PRICE	1	8.000000	0		
PROX	1	-4.000000	0		
WAIT	1	-2.000000	0		
FASTER	1	0	0		
CROWDED	1	-1.000000	0		
ONTIME	1	0	0		

SYSREG ON AN INDIVIDUAL BASIS
ID=142

MODEL: EQUI
DEP VAR: RANK

		SSE	1.000000	F RATIO	508.50
		DFE	9	PROB F	0.0001
		MSE	0.111111	R-SQUARE	0.9971

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	8.250000	0.220479	37.4185	0.0001
PRICE	1	8.000000	0.166667	48.0000	0.0001
PROX	1	-4.000000	0.166667	-24.0000	0.0001
WAIT	1	-2.000000	0.166667	-12.0000	0.0001
FASTER	1	-0.500000	0.166667	-3.0000	0.0150
CROWDED	1	-0.500000	0.166667	-3.0000	0.0150
ONTIME	1	-0.500000	0.166667	-3.0000	0.0150

SYSREG ON AN INDIVIDUAL BASIS
ID=148

MODEL: EQUI
DEP VAR: RANK

		SSE	1.250000	F RATIO	406.50
		DFE	9	PROB F	0.0001
		MSE	0.138889	R-SQUARE	0.9963

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB 1T1
INTERCEPT	1	8.125000	0.246503	32.9610	0.0001
PRICE	1	8.000000	0.186339	42.9325	0.0001
PROX	1	-4.000000	0.186339	-21.4663	0.0001
WAIT	1	-2.000000	0.186339	-10.7331	0.0001
FASTER	1	-0.250000	0.186339	-1.3416	0.2126
CROWDED	1	-0.250000	0.186339	-1.3416	0.2126
ONTIME	1	-0.750000	0.186339	-4.0249	0.0030

SYSREG ON AN INDIVIDUAL BASIS
ID=138

MODEL:	EQUI	SSE	2.000000	F RATIO	253.50
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	0.222222	R-SQUARE	0.9941

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0.311805	25.6571	0.0001
PRICE	1	8.000000	0.235702	33.9411	0.0001
PROX	1	-4.000000	0.235702	-16.9706	0.0001
WAIT	1	-1.500000	0.235702	-6.3640	0.0001
FASTER	1	-1.500000	0.235702	-6.3640	0.0001
CROWDED	1	0	0.235720		
ONTIME	1	0	0.235702		

SYSREG ON AN INDIVIDUAL BASIS
ID=141

MODEL:	EQUI	SSE	15.250000	F RATIO	31.94
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	1.694444	R-SQUARE	0.9551

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.375000	0.860999	9.7271	0.0001
PRICE	1	8.000000	0.650854	12.2915	0.0001
PROX	1	-3.000000	0.650854	-4.6093	0.0013
WAIT	1	-2.250000	0.650854	-3.4570	0.0072
FASTER	1	0	0.650854		
CROWDED	1	-1.250000	0.650854	-1.9206	0.0870
ONTIME	1	-0.250000	0.650854	-1.9206	0.0870

SYSREG ON AN INDIVIDUAL BASIS
ID=150

MODEL: EQUI

DEP VAR: RANK

		SSE	2.000000	F RATIO	253.50
		DFE	9	PROB F	0.0001
		MSE	0.222222	R-SQUARE	0.9941
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0.311805	25.6571	0.0001
PRICE	1	8.000000	0.235702	33.9411	0.0001
PROX	1	-4.000000	0.235702	-16.9706	0.0001
WAIT	1	-2.000000	0.235702	-8.4853	0.0001
FASTER	1	-0.500000	0.235702	-2.1213	0.0629
CROWDED	1	0	0.235702		
ONTIME	1	-0.500000	0.235702	-2.1213	0.0629

SYSREG ON AN INDIVIDUAL BASIS
ID=152

MODEL: EQUI

DEP VAR: RANK

		SSE	33.500000	F RATIO	13.72
		DFE	9	PROB F	0.0004
		MSE	3.722222	R-SQUARE	0.9015
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	6.250000	1.276116	4.8977	0.0009
PRICE	1	8.000000	0.964653	8.2931	0.0001
PROX	1	-3.250000	0.964653	-3.3691	0.0083
WAIT	1	-1.000000	0.964653	-1.0366	0.3270
FASTER	1	-0.250000	0.964653	-0.2592	0.8013
CROWDED	1	-1.000000	0.964653	1.0366	0.3270
ONTIME	1	0	0.964653		

SYSREG ON AN INDIVIDUAL BASIS
ID=157

MODEL:	EQUI	SSE	21.000000	F RATIO	22.79
		DFE	9	PROB F	0.0001
DEP VAR:	RANK	MSE	2.333333	R-SQUARE	0.9382

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	6.250000	1.010363	6.1859	0.0002
PRICE	1	8.000000	0.763763	10.4745	0.0001
PROX	1	-3.500000	0.763763	-4.5826	0.0013
WAIT	1	-1.500000	0.763763	-1.9640	0.0811
FASTER	1	0.500000	0.763763	0.6547	0.5291
CROWDED	1	1.000000	0.763763	1.3093	0.2229
ONTIME	1	0	0.763763		

SYSREG ON AN INDIVIDUAL BASIS
ID=158

MODEL:	EQUI	SSE	0	F RATIO	999999.99
		DFE	9	PROB F	0.0004
DEP VAR:	RANK	MSE	0	R-SQUARE	1.0000

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB |T|
INTERCEPT	1	8.000000	0		
PRICE	1	8.000000	0		
PROX	1	-4.000000	0		
WAIT	1	-2.000000	0		
FASTER	1	0	0		
CROWDED	1	-1.000000	0		
ONTIME	1	0	0		

REFERENCES

Agrawal, D.C., The Factors Affecting Mass Transportation Ridership: An Analysis. Transit Journal, Volume 4, (Summer 1978), 55-63.

Behnam, J. et al., Transit Service Improvements as Seen by Nonusers. Traffic Engineering, (May 1976), 18-21.

Belohlav, J.A. et al., Factors Influencing the Usage of Urban Mass Transit. The Logistics and Transportation Review, Volume 16, No. 2, (1980), 99-107.

Blankenship, D.P., Segmentation Analysis of Transit Users and Nonusers. Transportation Research Record 590, (1976), 1-4.

Bochner, B.S. et al., Analyzing Latent Travel Demands of Transit Dependents. Traffic Quarterly, (1978), 563-581.

Brown, G.R., Correlation of Socioeconomic Factors with Corridor Travel Demand. Transportation Research Record 499, (1974), 34-44.

Bureau of Management Consulting, The Ottawa Bus Pass System, An Examination of Effects. Department of Supply and Services, (September 1977).

Chada, H.S. et al., Bus Passenger Survey in Small Cities. Traffic Quarterly, (1977), 515.

Cleroux, M. et al., A Modal Choice Function for Winnipeg: Calibration and Validation. Centre de Recherce sur les Transports, (1979).

Cohen, S.H. et al., Travel Behavior Among Elderly Non Users of Reduced Rate Transit Service. Traffic Quarterly, (April 1980).

Constantino, D.P., Attributes of Transit Demand. Traffic Quarterly, Volume 29, (1975), 243-257.

Crosby, T., Free Fares, Will It Work. Mass Transit 5, (May 1979).

Crosby, T., A Transit Poll for 2 Cities. Mass Transit 7, (May 1981), 30-34.

Day, George S. and Associates, An Assessment of the Potential for Improving Urban Transit Marketing in Canada. Working Paper prepared for Urban Transportation Research Branch, Canadian Surface Transportation Administration, Transport Canada, (1978).

Dobson, R. et al., Structural Models for the Analysis of Traveler Attitude-Behavior Relationships. Transportation 7, (1978), 351-363.

Environics Research Group, 1980 Public Attitude Survey, Summary Report. For Toronto Transit Commission, (March 1981).

Ferreri, M.G., Transit Price Elasticities Revisited. Transit Journal, (Summer 1979), 65-71.

Fielding, G.J. et al., Consumer Attitudes Toward Public Transit. Transportation Research Record 563, (1976).

Frankena, M.W., The Demand for Urban Bus Transit in Canada. Working Paper, (July 1978).

Gaudry, M.J.I., A Dogit Model of Travel Mode Choice in Montreal. Centre de Recherce sur les Transports, (1978).

Gensch, D.H. et al., Perceived Difference Segmentation Model for Mass Transit Marketing. Transportation Research Record 765, (1980), 16-22.

Gilbert, G. et al., The Importance of Attitudes in the Decision to Use Mass Transit. Transportation 6, (1977), 321-332.

Gillan, D.W., The Effects of Federal Government Parking Policy on Modal Choice Among Federal Government Employees in Ottawa. Working Paper, Transport Canada Research and Development Centre, Montreal, (March 1977).

Gillan, J. et al., Lifestyles and Transportation Needs of the Elderly in Los Angeles. Transportation, Volume 5, (1976).

Golden, L.L. et al., A Programmatic Research Approach to Transit Marketing. Traffic Quarterly, Volume 34, No. 4, (October 1980), 627-647.

Gratwick, J., Transport Verities and Myths. Logistics and Transportation Review, Volume 16, No. 4, (June 11, 1980), 307-312.

Guilano, G., Public Transportation and the Travel Needs of Women. Traffic Quarterly, (1979), 607-610.

Guseman, P.K. et al., Segmenting the Transit Market in Smaller Cities. Transit Journal, Volume 4, (1978).

Hanson, Susan, The Importance of the Multi-Purpose Journey to Work in Urban Travel Behavior. Transportation 9, (1980), 229-248.

Hartgen, D.T., A Note on the Ability of Socioeconomic Variables to Explain Attitudinal Bias Toward Alternative Travel Modes. High Speed Ground Transportation Journal, (1972), 201.

Hartgen, D.T., Attitudinal and Situational Variables Influencing Urban Mode Choice: Some Empirical Findings. Transportation, Volume 3, (4), (1974), 377-392.

Henley, D.H. et al., Changes in Perceived Travel Cost and Time for the Work Trip During a Period of Increasing Gasoline Costs. Transportation, Volume 10, (1981), 23-34.

Hensher, D.A., Market Segmentation as a Mechanism in Allowing for Variability of Traveler Behavior. Transportation, Volume 5, (1976), 257-284.

Hickey, T.J., Market Research - The Key to Opportunity. Transit Journal, Volume 4, (1978).

Hoag, L.L., Human Factors in Urban Transportation Systems. Human Factors, Volume 17, No. 2, (1975), 119-131.

Hsu, J., Effects of Multi-Car Ownership on Use of Public Transit. Perceptual and Motor Skills, Volume 41, (1975), 369-370.

Keck, C.A. et al., Characteristics and Attitudes of Dial-a-Bus and Park and Ride Users in New York State. Transportation Research Record 590, (1976).

Kingham, R.I., Automobile Availability Per Worker: A Transportation System Sensitive Socioeconomic Variable. Transportation Research Record 673, (1978), 202-208.

Koppelman, F.S., Guidelines for Aggregate Travel Prediction Using Disaggregate Choice Models. Working Paper, Transportation Center, Northwestern University, (May 1976).

Koppelman, F.S., et al., Travel Choice Behavior: Models of Perceptions, Feelings, Preference, and Choice. Transportation Research Record 765, (1980), 26-33.

Lago, A.M. et al., Transit Ridership Responsiveness to Fare Changes. Traffic Quarterly, Volume 35, No. 1, (January 1981), 117-142.

Lea, N.D. and Associates, The Identification of Factors Affecting Miles Travelled by Private Vehicles. (1975).

Lovelock, C.H., Balanced Transportation Planning for Suburban and Academic Communities. Stanford Workshops on Political and Social Issues, (1973).

Luehring, D.W. et al., An Attitudinal Research Study of Single Occupancy Drivers and Ferry Riders. Traffic Quarterly, (January 1981).

Lyman, P., Transport Canada, MAR, (April 1975).

Mohan, S. et al., Pay and Ride Carpool: A New Concept in Commuter Ridership. Transportation Research Record 778, (1980), 1-7.

Mitchelson, R.L. et al., Examination of the Psychophysical Function in Travel Mode-Choice Behavior. Transportation Research Record 750, (1980), 27-32.

Moses, L.N. and Williamson, H.F., Jr., Value of Time, Choice of Mode, and the Subsidy Issue in Urban Transportation. Journal of Political Economy, 71, (June 1963), 247-264.

Mossman, F. et al., Mobility Index Based on the Socioeconomic Characteristics of Households. Traffic Quarterly, (1975), 347.

Nash, C.A., Public vs. Private Transport. (1976).

Oppenhiem, N., A Typological Approach to Individual Urban Travel Behavior Prediction. Environment and Planning, A, Volume 7, (1975), 14-152.

Pant, P.D. et al., Urban Activities, Travel, and Time: Relationships from National Time-Use Survey. Transportation Research Record 750, (1980), 1-5.

Passenger Transport, Marketing Programs Draw 500,000 Additional Riders to Spor Tran. (March 13, 1981).

Passenger Transport, Edmonton Residents Rate Transit Service and Needs. (March 27, 1981).

Passenger Transport, Setting Priorities and the Defence Plan for the Day Consumer Information Dies. (June 12, 1981).

Presage Research, Year 1990: Transit Ridership Forecasts. For Urban Transportation Research Branch of Canadian Surface Transportation Administration, Transport Canada, (June 1978).

Presage Research, A Review of Canadian Urban Passenger Mode Choice Models. Urban Transportation Research Branch of the Canadian Surface Transportation Administration, Transport Canada, (August 1979).

Presage Research, Analysis of Canadian Urban Household Auto Ownership. Urban Transportation Research Branch of the Canadian Surface Transportation Administration, Transport Canada, (November 1980).

Riechman, S., Instrumental and Life Style Aspects of Urban Trvel Behavior. Transportation Research Record 699, (1979), 38-42.

Rosapep, T.J., Market Segmentation: A Review of its Use and Application for Transportation Analysis. University of Toronto/York University Joint Program in Transportation, (1980).

Stern, E. et al., The Effect of an Intercity Public Transport Network on Bus Patronage. The Logistics and Transportation Review, Volume 16, No. 2, (1980), 109-123.

Stopher, P.R., The Application of Psychological Measurement Techniques to Travel Demand Estimation. Environment and Behavior, Volume 9, No. 1, (March 1977), 67-80.

Systems Approach Limited, An Inventory of the Automobile Non User in Canada. Working Paper, Urban Transportation Research Branch of the Canadian Surface Transportation Administration, Transport Canada, (January 1979).

Toronto Transit Commission Marketing and Community Relations Plan. (1981).

Transit Canada Magazine, Ottawa Transit Pass, An Unqualified Success. (November-December 1976), 19.

Transportation Model Development Programme, A Model of Individual's Choice of Travel Mode. Transportation Department, Regional Municipality of Ottawa-Carleton, (1979).

Ugge, A.J. et al., Short Term Effects of Urban Transit Fare Increases in Ontario Cities. Project No. 3314, Transit Systems Research, Systems Research and Development Branch, Ministry of Transportation and Communication, Downsview, (February 1977).

Vancouver Car Pool, Carpooling in an Urban Transportation Environment: A Study. Bureau of Management Consulting for the Transportation Development Agency, (March 1977).

van der Hoon, Toon, Travel Behavior and the Total Activity Pattern. Transportation 8, (1979), 309-328.

Vanier, D.J., Consumer Psychographics: Transit Rider and Non Rider Market Segments. Transit Journal, (Winter 1979), 35-44.

Vanier, D.J. et al., Mass Transit: Devising a Research Based Marketing Plan. Transportation Research, Volume 11, (1977), 245-253.

Warrington, J.E., Informational and Promotional Programs to Increase Transit Ridership. Transit Journal, (Winter 1981).

Webber, M.W., Current Issues in Transportation Policy; the BART Experience - What Have We Learned?

Whittle, R., Price and Quality Mixture: A Cure for All Ills. Transport, (January-February 1981), 47-51.

Wiese, A.E., Public Opinion - A Mixed Bag for Transit. Mass Transit, (September 1978), 24-34.

Zahavi, Y. et al., Regularities in Travel Time and Money Expenditures. Transportation Research Record 750, (1980), 13-18.

Zarembka, P., ed., Frontiers in Econometrics. New York: Academic Press, (1973).